4A. DIRECT AND INDIRECT IMPACTS – ALTERNATIVE A

4A.1 INTRODUCTION

This section provides an analysis of the environmental consequences that would result from implementation of Alternative A – CPAI Development Plan Impacts on Terrestrial Vegetation and Wetlands and Full-Field Development Plan Impacts on Fish.

The CPAI Development Plan includes five production pads, CD-3 through CD-7. Produced fluids would be transported by pipeline to be processed at APF-1. Gravel roads would connect CD-4 through CD-7 to CD-1. CD-3 would be accessed by ice road or by air. Gravel used for construction of roads, pads, and airstrips would be obtained from the existing ASRC Mine site and the Clover Potential Gravel Source. A bridge across Nigliq Channel near CD-2 would accommodate road traffic and the pipelines. CD-3 would be the only new pad with an airstrip. CD-6 would be within a 3-mile setback from Fish Creek in which the BLM's ROD for the Northeast NPR-A IAP/EIS (BLM 1998b) (Stipulation 39[D]) prohibits permanent oil facilities. This alternative would provide for an exception to this provision to allow location of CD-6 and its associated road and pipeline within the setback. Additional exceptions would be required to locate oil infrastructure within 500 feet of some waterbodies (Stipulation 41), and to allow roads connecting to a road system outside the NPR-A (Stipulation 48). Aboveground pipelines would be supported on VSMs and would be at elevations of at least 5 feet above the tundra. Power lines would be supported by cable trays placed on the pipeline VSM, except for a power line suspended from poles between CD-6 and CD-7.

The FFD alternative includes two hypothetical APFs and 22 hypothetical production pads in addition to the five production pads proposed by CPAI. Gravel roads would connect all but six production pads. Five productions pads in the lower Colville River Delta (CD-3, and hypothetical production pads CD-14, CD-19, CD-21, and C-22), and one hypothetical production pad near the Kogru River (CD-29) would be designed with airstrips for access, instead of roads. Construction and operation strategies described for the applicant's proposed action would apply for the FFD scenario. Exceptions to the stipulations in the Northeast NPRA-A IAP/EIS and ROD would be necessary to allow placement of facilities in certain areas.

4A.2 PHYSICAL CHARACTERISTICS

4A.2.1 Terrestrial Environment

4A.2.1.1 Physiography

Alternative A – CPAI Development Plan Impacts on Physiography

Construction Period

The impacts to physiography would result from changes to landforms by construction of roads, pads, airstrips, and gravel mines. Impacts would be localized to the immediate footprint of the facilities and gravel mines and the immediate surroundings. Surface terrain would change because of placement of gravel roads and pads. Placement of gravel on the tundra for roads, pads, and airstrips creates a raised terrain feature that would directly affect physical characteristics, such as the thermal regime and hy drology, if not properly accounted for in the design. As an example, if the thickness of the road embankment is not adequate to maintain thermal stability, then the permafrost below the road could begin to melt, creating thaw subsidence (thermokarsting) adjacent to the road. This would lead to settlement of the roadbed, subsequent structural failure, and increased ponding (Frederick 1991).

New gravel mine sites would affect the existing tundra surface by complete removal of the surface vegetation and overburden and extraction of the underlying gravels. Depending on site-specific conditions, a large disturbance such as this could cause melting of the permafrost soils around the mine site perimeter, which would create additional landform changes. Gravel mining leaves a large hole in the ground. This could result in the creation of shallow and deep-water habitats. If ponds are created, they would likely be much deeper than the typical North Slope lake, and as is typical under a water body that does not freeze completely during winter, thaw bulb formation likely would follow.

Gravel mines could affect about 65 acres. Areas that would experience direct physiographic effects from placement of gravel on the tundra include 270 acres.

Operation Period

Compared to the landscape that would be altered by original construction, the operational phase of the facilities would have relatively little effect on landforms. Maintenance grading of the surfaces of pads and roads would modify the surface, but the general shape of the road and pads would be the same throughout the life of the facility.

Snow accumulations from wind drifting and snow plowing would increase the meltwater runoff or ponding in certain localized areas adjacent to roads and pads where gravel fill or overburden placed on the tundra surface impedes the downslope movement of water. Some impedances simply increase soil moisture content on the upslope side of the barrier, while others create ponds. Ponds could dry up during the summer, or they could become permanent water bodies that persist from year to year Walker et al., 1987a, Walker 1996) and potentially disturb gravel structures. Project design aspects intended to reduce these effects include orienting pads to minimize wind drift accumulations, using the natural slope or culverts to alleviate ponding, and depositing snow for removal operations in designated areas, which would limit ponding during the summer melting period (Frederick 1991).

Alternative A – Full-Field Development Plan Impacts on Physiography

The ASRC Mine Site and Clover Potential Gravel Source would experience direct physiographic effects from gravel mining operations. Areas that would experience direct physiographic impacts from the tundra gravel placement include 270 acres for CPAI and 1,399 acres for FFD.

Alternative A – Summary of Impacts (CPAI and FFD) on Physiography

Impacts to physiography occur primarily during the construction phase and result from changes to landforms by construction of roads, pads, airstrips, and mine sites. If not properly designed and constructed, these landforms can adversely affect thermal stability of the tundra and hydrology through thermokarsting and increased ponding.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Physiography

No measures have been identified to mitigate impacts to physiography under Alternative A or Alternative A FFD.

4A.2.1.2 Geology

The following discussion of impacts to geological resources is limited to lithified, inorganic materials and their associated petroleum resources. The impact to unconsolidated material is discussed in Section 4A.2.1.

Alternative A – CPAI Development Plan Impacts on Geology

<u>Construction Period</u>

Direct Effects

The only surface bedrock identified in the ASDP Area outcrops at the bend in the lower Colville River upstream of Ocean Point (Mayfield et al. 1988). Alternative A does not propose excavation activities in this area and would therefore not directly affect surface bedrock.

Indirect Effects

No indirect effects are recognized for the construction period.

<u>Operation Period</u>

Direct Effects

Drilling oil production wells at the five pad locations would directly affect the target and overlying lithologies. Annular disposal or Class II reinjection of drilling wastes would directly affect the receiving lithologies. The volume of rock affected in conjunction with drilling and the disposal of drilling waste is insignificant compared to the volume of lithified resources present within the ASDP Area. For this reason, direct impacts to ASDP Area litholgy are considered negligible.

The CPAI Development Plan would produce hydrocarbons from subsurface reservoirs, thereby depleting the *in situ* petroleum reserves. Although hydrocarbon production constitutes an unavoidable and permanent impact that would not recover to its pre-impact state within the scale of human longevity, the impact is confined to the geological environment, and economic gains would likely outweigh adverse impact to petroleum resources.

Indirect Effects

No indirect effects are recognized for the operation period.

Alternative A – Full-Field Development Plan Impacts on Geology

Direct and indirect impacts incurred during construction and operation of Alternative A FFD would be similar to those presented in Section 4A.2.1, but would be experienced over greater spatial and temporal extents. The volume of rock affected in conjunction with drilling and the disposal of drilling waste under FFD is also considered insignificant when compared to the volume of lithified resources present within the Plan Area. Surface bedrock is not expected to be affected under the FFD scenario. Full-field development would further deplete Plan Area petroleum reserves; however, the hypothetical nature of FFD precludes quantification of petroleum resource reduction.

Alternative A – Summary of Impacts (CPAI and FFD) on Geology

Reduction of petroleum resources in the ASDP Area is inevitable. Because these resources are essentially non-renewable, effects would be permanent and unresponsive to mitigation. Impacts to lithified resources in the ASDP Area under the Alternative A – CPAI Develoment Plan and Alternative A FFD would produce no measurable effect.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Geology

No measures have been identified to mitigate impacts to geological resources under Alternative A or Alternative A FFD.

4A.2.1.3 Soils and Permafrost

Impacts incurred during the construction and operation affecting the mechanical and thermal properties of the soil also would modify permafrost distribution. This intimate relationship between soil and permafrost prompts a joint discussion of impacts to the systems in this and other alternatives. Impacts specific to sand and gravel resources are discussed in separate subsections for each alternative.

Alternative A – CPAI Development Plan Impacts on Soils and Permafrost

Construction Period

Direct Effects

Impacts to soils and permafrost in the Plan Area during construction are primarily related to excavation and placement of fill.

Development of new gravel mine sites would require excavation of overburden from approximately 65 acres, based on extrapolations from the excavation experience at the ASRC Mine in 1999 to 2000. The overburden could be stockpiled temporarily on ice pads adjacent to the mine site. Any stockpiled material would be replaced and recontoured at the conclusion of excavation in accordance with final reclamation plans for the mine site. Excavation and boring of soil compromises the integrity of the rooted layer and destructs soil structure in the immediate area of impact.

Fill material placed in conjunction with Alternative A would overlie approximately 270 acres of native soil. The total surface area of ice roads constructed over six seasons would overlie approximately 1,096 acres of native soil during the winter months. Placement of fill directly on the tundra surface decreases the porosity and permeability of the underlying soil.

Landscape scarring resulting from excavation and placement of fill is particularly damaging in the arctic because of the slow rate of pedogenesis (soil formation). Soils in the Plan Area are subjected to cold and anoxic conditions that retard pedogenesis, allowing exposed mineral soil layers to persist for decades.

Indirect Effects

Indirect effects of construction to soil and permafrost are typically commensurate with the lateral and vertical extents of the direct impact. The permafrost layer would be affected initially during the construction period, but effects would not be manifested immediately. For this reason, impacts to permafrost are discussed as indirect effects.

Removal of insulating vegetation and rooted soil layers would increase local susceptibility to erosion and degrade the underlying permafrost table. Destruction of the organic soil horizon also poses implications for hydrocarbon spill migration. Hydrocarbons spilled to organic matter are adsorbed to the negative surface of the constituents. In the absence of an intercepting organic layer, hydrocarbons are more likely to contaminate surface water and supra-permafrost groundwater.

The addition of fill would allow permafrost aggradation resulting from increased compaction and insulation of underlying soils. Soil compaction would reduce hydraulic conductivity and could induce ponding and permafrost degradation hydrologically upgradient of the filled area.

Permafrost aggradation and degradation could compromise the structural integrity of overlying infrastructure. Buildings could be damaged if the force of ice expansion overcomes the normal force of overlying infrastructure. Degradational features could cause subsidence of infrastructure because of poor bearing strength of saturated, fine-grained sediment (Pewe 1966). It is unlikely that infrastructure would be affected by any equilibration of permafrost if design specifications are met.

Operation Period

Direct Effects

Impacts related to operation include effects of overland travel and conduction of heat from infrastructure to the surrounding soil. Depending on frequency and concentration of use, motorized and non-motorized travel on unfrozen tundra could destroy vegetation and organic and mineral soils. Vehicle travel on ice and gravel roads in the Plan Area would compact the underlying active layer.

Installation of subsurface infrastructure provides a thermal conduit between the ground surface and subsurface layers, thereby rendering local permafrost in disequilibrium with the new thermal regime. Heat conducted from buildings, well casings and VSMs would degrade the extent of local permafrost (Gyrc 1985). Approximately 3,412 VSMs would be embedded within the pipeline corridors delineated for Alternative A; five well clusters would be drilled in conjunction with Alternative A.

Indirect Effects

Soil compaction resulting from on-road vehicle traffic could increase localized ponding and permafrost degradation. Destruction of tundra vegetation and organic and mineral soils resulting from off-road travel would cause additional erosion. Degradation of permafrost beneath heated infrastructure could initiate or exacerbate any impact sustained to the structural integrity of the overlying improvements.

Alternative A – Full-Field Development Plan Impacts on Soils and Permafrost

The types of impacts and associated effects of FFD are similar to those presented in Section 4A.2.1, Alternative A – CPAI Development Plan, but would be experienced over greater spatial and temporal extents. Additional gravel mine sites would be developed to provide the volume of construction material necessary for FFD**.** Based upon the condition and depth experience from 1999 to 2000 excavation at the ASRC mine, FFD might disturb surface soils and permafrost of approximately 346 acres. This area is about 0.04 percent of the total Plan Area.

Colville River Delta Facility Group

Fill material placed in conjunction with Alternative A FFD would overlie approximately 278 acres of native soil in the Colville River Delta area. The total surface area of ice roads constructed over 20 seasons would overlie approximately 680 acres of native soil during the winter months. Approximately 3,565 VSMs would be embedded and seven additional oil well clusters would be drilled in the Colville River Delta area.

Fish-Judy Creeks Facility Group

Fill material placed in conjunction with Alternative A FFD would overlie approximately 720 acres of native soil in the area of the Fish-Judy Creeks Facility Group. The total surface area of ice roads constructed over 20 seasons would overlie approximately 120 acres of native soil during the winter months. Approximately 5,347 VSMs would be embedded and a minimum of 12 additional oil well clusters would be drilled in the area of Fish and Judy Creeks.

Kalikpik-Kogru Rivers Facility Group

Fill material placed in conjunction with Alternative A FFD would overlie approximately 401 acres of native soil in the area of the Kalikpik and Kogru rivers. The total surface area of ice roads constructed over 20 seasons would overlie approximately 475 acres of native soil during the winter months. Approximately 8,911 VSMs would be embedded and a minimum of five additional oil well clusters would be drilled in the Kalikpik-Kogru Rivers Facility Group.

Alternative A – Summary of Impacts (CPAI and FFD) on Soils and Permafrost

Most impacts to soil and permafrost under CPAI Development Plan Alternative A and FFD Alternative A would be sustained during construction. Effects on the environments are unavoidable and semi-permanent, but less than 1 percent of the total soil and permafrost system surface area within the Plan Area would be affected. Soil and permafrost systems could recover to their pre-impact state but not without appropriate mitigation.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Soils and Permafrost

Specific construction and design measures would include use of silt fencing, incorporation of temporary ground coverings, diversion of runoff from exposed ground surfaces, and a shallow finish grade to reduce the velocity of overland flow and subsequent extent of erosion.

Where impact to soil and permafrost cannot be avoided, mitigation measures that aim to rectify the effect of the impact would be implemented. Excavated areas would be rehabilitated by an appropriate combination of topsoil addition, reseeding, fertilizing, and irrigation. Revegetation would reduce erosion and allow reaggradation of locally depressed permafrost tables. Soil and permafrost underlying gravel might return to their pre-impact state if removal of gravel fill is required upon abandonment.

4A.2.1.4 Sand and Gravel

Once used, sand and gravel resources for construction of roads, pads, or airstrips could only be available for reuse upon abandonment.

Alternative A – CPAI Development Plan Impacts on Sand and Gravel

Construction Period

The estimated volume of gravel needed for Alternative A is 2.26 million cubic yards.

Operation Period

During the operation period, small amounts of gravel are expected to be extracted from existing permitted mine sites for repair of road and pad embankments (for example, if a washout occurs).

Alternative A – Full-Field Development Plan Impacts on Sand and Gravel

FFD Alternative A would use and build off of the same road network that would be constructed under the applicant's proposed project, Alternative A. FFD Alternative A, depicted in Figure 2.4.1.2-1, is estimated to need 12.1 million cubic yards (Tables 2.4.1-6 and 2.4.1-7) of gravel. Outside of, possibly, the Clover Potential Gravel Source, the source of this gravel has not yet been determined.

If alternative embankment designs such as use of insulation in embankments are used during FFD (see discussion in Section 2.3.1), less sand and gravel would be affected.

Alternative A – Summary of Impacts (CPAI and FFD) on Sand and Gravel

Once used, sand and gravel resources for construction of roads, pads, or airstrips could only be available for reuse upon abandonment. Removal of gravel fill is not currently a scheduled phase of abandonment.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Sand and Gravel

No measures have been identified to mitigate impact to sand and gravel resources under Alternative A or Alternative A FFD.

4A.2.1.5 Paleontological Resources

Paleontological resources are nonrenewable. Once they are adversely impacted or displaced from their natural context, the damage is irreparable.

Alternative A – CPAI Development Plan Impacts on Paleontological Resources

Because paleontological resources are not ubiquitous in the Plan Area as are habitat and wildlife, it is quite possible that the applicant's proposed development activities would have no impact on paleontological resources, simply because the activities occur where paleontological resources are not present (BLM and MMS 1998a). The only known paleontological sites in the Plan Area are found outside of areas likely to be disturbed by the applicant's proposed development, with the heaviest concentration of known fossil localities in the vicinity of Ocean Point on the bank of the Colville River approximately 13 miles southwest of Nuiqsut. Places of particular concern are those areas that have bluff exposures.

<u>Construction Period</u>

The likelihood of affecting surface paleontological materials in the Plan Area is low because of their isolated and rare occurrence.

The primary source of potential impacts to paleontological resources would result from the excavation of sand and gravel material at the ASRC Mine Site and the Clover Potential Gravel Source. Surface disturbance at these sites would be approximately 65 acres. Extraction of sand and gravel from these sites could affect paleontological resources.

Drilling of as many as 150 production wells could occur under Alternative A. Subsurface disturbance that would occur as a result of the drilling would be limited to the annulus of the well bore itself. It is possible that drilling the boring could affect important accessible paleontological material, but the likelihood of that occurrence is very small.

Pipelines and overhead power lines would be constructed during the winter months from ice roads and pads. Therefore, the only impact resulting from pipeline and power line construction would be associ ated with placement of approximately 3,180 VSMs and placement of power poles between CD-6 and CD-7 as an option. Depending on the depth at which the VSMs and poles are set, it is possible—though highly unlikely—that paleontological resources would be affected.

Vehicle bridges at river crossings would be constructed during the winter months from ice roads and pads. Therefore, the only impact resulting from bridge construction would be associated with placement of sheet piling at bridge abutments and foundation piles at abutments and in-stream locations. Depending on the depth at which the pilings are set, it is possible—though highly unlikely—that paleontological resources would be affected.

Operation Period

No additional impacts to paleontological resources are expected during the operational period unless infrastructure is expanded (for example, pads are expanded or bridges are widened).

Alternative A – Full-Field Development Plan Impacts on Paleontological Resources

Under the hypothetical FFD scenario for Alternative A, the mechanisms associated with impacts to paleontological resources would remain the same as those described under Alternative A for the ASDP Area, except the greater extent of the development would increase the intensity of the actions. the primary potential cause of impacts would be excavation of gravel on approximately 346 acres. Approximately three gravel mine sites would be developed to provide the volume of construction material necessary for FFD. The location of the gravel mine sites for FFD is yet unknown, but could be in locations that would affect paleontological resources. It is likely that the additional sand and gravel mine sites would be situated in the vicinity of the Fish-Judy Creeks Facility Group and/or the Kalikpik-Kogru Rivers Facility Group. In addition, approximately 1,400 acres could be covered by gravel in the construction of pads, roads, and airstrips.

Alternative A – Summary of Impacts (CPAI and FFD) on Paleontological Resources

Surface activities such as construction of pad, road, and airfield embankments are not likely to affect paleontological resources. Impacts could result from those activities involving subsurface disturbance such as production well drilling, sand and gravel mining, and installation of VSMs, power poles, and bridge piles. Excavation of sand and gravel under approximately 65 acres for CPAI's project and 346 acres for FFD constitute the greatest risk to paleontological resources.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Paleontological Resources

No additional measures have been identified to mitigate impacts to paleontological resources under Alternative A or Alternative A FFD.

4A.2.1 Aquatic Environment

4A.2.1.1 Water Resources

Alternative A – CPAI Development Plan Impacts on Water Resources

Potential impacts to groundwater, surface water (lakes and streams), estuaries, and the nearshore environment could result from construction and operation activities associated with the CPAI Development Plan. Elements that could affect water resources include gravel roads, ice roads, pipelines, production pads, bridges, airstrips, camp discharges, chemical/petroleum tank storage, well reinjection, and water supply extraction for potable water and construction use. Potential impacts would typically fall into one or more of the following nine categories:

1. Shoreline disturbance and thermokarsting
2. Blockage or convergence of natural drainage
3. Increased stages and velocities of floodwater
4. Increased channel scour
5. Increased bank erosion
6. Increased sedimentation
7. Increased potential for over-bank flooding
8. Removal of surface soils and gravel and changes in recharge potential
9. Chemical and petroleum spills.

Construction Period

Table 4A.2-1 summarizes potential construction impacts to satellite locations CD-3, CD-4, CD-5, CD-6, and CD-7 for each water resource.

Impacts to Subsurface Water

Specific localized deep groundwater zones could be affected by the practice of disposing of drilling wastes (mud and cuttings) by annular disposal into sands below the permafrost in permitted development wells. Because groundwater below permafrost is typically saline, potable water sources are not expected to be affected. USEPA criteria would be used to determine if there are underground sources of drinking water. These are defined as water containing dissolved solids less than 10,000 ppm and capable of providing sufficient quantity. Given the location and the availability of surface waters, it is likely that findings of no aquifers or an aquifer exemption would be put in place. The Alaska Oil and Gas Conservation Commission (AOGCC), on proper showing, can exempt an aquifer with total dissolved solids between 3,000 and 10,000 ppm.

Approved drilling wastes would be injected at approved volumes and rates into the approved Class II disposal wells at CD-1, not new wells at the satellites. Since groundwater from these potentially affected zones would not be extracted and used for potable or construction activities, no impacts are expected.

Local shallow thawed water-bearing zones could be affected during the construction, operation, and rehabilitation of any gravel mine. These supra-permafrost zones could be enlarged or eliminated by the removal of shallow surface soils, blasting and excavation of gravel, and rehabilitation of the site. Rehabilitation would include allowing natural flows to fill the mine site excavation. In general, the construction of all the production pads could temporarily affect shallow subsurface water (or the hyporheic zones that exist as thaw bulbs around lakes and streams) and could temporarily change the thickness and vertical location of the active thaw zone.

TABLE 4A.2-1 POTENTIAL CONSTRUCTION IMPACTS TO WATER RESOURCES

Alternative A – CPAI Development Plan

	Groundwater		Lakes		Major and Minor Stream Crossings					ESTUARIES and NEARSHORE ENVIRONMENT	
CD-3											
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Ulamnigiaq Channel	Tamayagiaaq Channel	Sakoonang Channel	Colvville River	Minor Streams	Collville River Delta	Harrison Bay
Gravel Road Segment: CD-3 to Airstrip	8	NI	NI	NI	NI	NI	NI	NI	NI	7	NI
Ice Roads	NI	NI	10	10	3?	NI	NI	NI	3	3	NI
Airstrip	8	NI	NI	NI	2,3,4,5	NI	NI	NI	NI	6	NI
Pipeline Segment: CD-1 - CD-3	NI	NI	NI	NI	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	NI	3,4,5,6,7	6	NI
Production Pad	8	NI	NI	8	2,3	2,3	2,3	NI	2,3	6	NI
Underground injection	NI	9	NI	NI	NI	NI	NI	NI	NI	NI	NI
Chemical/Petroleum Tank Storage	9	NI	9	9	9	NI	NI	NI	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	NI	NI	NI

CD-4							
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Nigliq Channel	Minor Streams	Harrison Bay
Gravel Road Seg. CD-1 to CD-4	8	NI	NI	NI	NI	2,3,4,5,6	NI
Pipeline Segment: CD-1 - CD-4	NI	NI	NI	NI	NI	2,3,4,5,6	NI
Production Pad	8	NI	8	NI	NI	2,3,4,5,6	NI
Underground injection	NI	9	NI	NI	NI	NI	NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI

TABLE 4A.2-1 POTENTIAL CONSTRUCTION IMPACTS TO WATER RESOURCES (cont'd)

Alternative A – CPAI Development Plan

	Groundwater		Lakes		Major and Minor Stream Crossings		Estuaries and Nearshore Environment
CD-5							
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Nigliq Channel	Minor Streams	Harrison Bay
Gravel Road Segment: CD-2 -CD-5	8	NI	NI	NI	2,3,4,5,6,7	2,4,5,6	NI
Pipeline Segment: CD-2 -CD-5	NI	NI	NI	NI	2,3,4,5,6,7	6	NI
Production Pad	8	NI	8	NI	NI	NI	NI
Bridges/Culverts	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Underground injection	NI	9	NI	NI	NI	NI	NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	NI	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI

	Groundwater		Lakes		Major and Minor Stream Crossings			Estuaries and Nearshore Environment
CD-6								
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish-Judy Creek Basin	Ublutuoch River Basin	Minor Streams	Harrison Bay
Gravel Road Segment: CD-5 - CD-6	8	NI	5,6	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Pipeline Segment: CD-5 - CD-6	NI	NI	5,6	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Production Pad	8	NI	8	NI	NI	NI	NI	NI
Bridges/Culverts	NI	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI

TABLE 4A.2-1 POTENTIAL CONSTRUCTION IMPACTS TO WATER RESOURCES (cont'd)

Alternative A – CPAI Development Plan							
	Groundwater		Lakes		Major and Minor Stream Crossings		Estuaries and Nearshore Environment
CD-7							
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish-Judy Creek Basin	Minor Streams	Harrison Bay
Gravel Road Segment: CD-6 - CD-7	8	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Pipeline Segment: CD-6 - CD-7	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Production Pad	8	NI	8	NI	NI	NI	NI
Bridges/Culverts	NI	9	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI

Notes:

1 = Shoreline Disturbance & Thermokarsting
2 = Blockage of Natural Channel Drainage
3 = Increased stages & velocities of floodwater
4 = Increased channel scour
5 = Increased Bank Erosion
6 = Increased Sedimentation
7 = Increased potential for over banking (due to inundation or wind-generated wave run-up)
8 = Removal of surface soils/gravel and changes in recharge potential
9 = Chemical & Petroleum Spills & Cleanup
10 = Water Supply Demand
NI = No Impact

Impacts to Surface Water

Impacts Associated with Water Supply Demands. Lakes would supply fresh water for the construction of ice roads and pads during the winter construction seasons, for hydrostatic testing of newly installed pipelines, for potable water at temporary construction or drilling camp facilities and for mud-plant operations during drilling. These activities would have minor short-term (seasonal) impacts on water levels of small lakes and would have a negligible effect on larger deep lakes. Long-term effects on lake water levels are not expected because natural annual recharge processes are sufficient to fully recharge the lakes each year.

Water Demand. The water demand during construction and maintenance of ice roads and pads is expected to be approximately 1 million gallons (or 3.1 acre-feet [ac-ft]) of water per mile of constructed road. The estimates for the periods of ice-road construction provided in Section 2.0 indicate that annual demands for lake water could range from 15 to 300 ac-ft per year (or approximately 5 to 98 million gallons per year) over the 6 years of ice-road construction. The estimated maximum annual water demand for ice-road construction is roughly 1.5 times the annual water demand in 2002 (64.7 million gallons—see Table 4A.2-2), which, as noted above, used only 3 percent of the total permitted lake volume. Water withdrawals are usually made from the nearest or largest permitted lakes along the route. Because it is sometimes difficult to predetermine which lakes will be used for ice road development, permitting of additional lakes could be needed in the future.

Approximately 38,000 gallons per day, or 3.5 ac-ft per month, of water would be required to support drill rig and mud plant operations at each satellite location, and an additional, 5,000 gallons per day, or 0.46 ac-ft per month, of potable water would be used by the drilling camp until drilling is complete. Thus, activities at each pad would consume approximately 1.3 million gallons per month (4 ac-ft per month). Fresh water also would be used during any additional drilling or fire-fighting activities over the long term.

Recent Monitoring of Impacts to Lakes Associated with Water Withdrawals. Minimum lake water depths required and total permitted volumes for extraction have been established by the Alaska Department of Fish and Game (ADF&G), including sustained withdrawal, based on surface water flow during spring break-up events (Table 4A.2-2). Table 4A.2-2 also summarizes the volumes of water withdrawn from permitted lakes in the Plan Area during the winter of 2002 and shows the percentage of each lake volume used of the total permitted lake volume. The data indicate that for each lake the proportion of pumped- to permitted-lake volume was highly variable (ranging from 0.3 to 86 percent) during the 2002 exploration season, but the total lake volume used from all lakes combined was only 3 percent (Michael Baker Jr., Inc. [Michael Baker] 2002e) of the total available permitted volume. Michael Baker (2002e) conducted monitoring and recharge studies of lakes in the Plan Area designed to evaluate the magnitude and impacts of water withdrawn for ice road/pad construction during exploration activities from these lakes. The studied lakes included five pump lakes: L9911, L9817, M9912, M9922, and M9923, and four reference lakes: L9807, L9823, M0024, and M9914. Site visits were conducted so that lake conditions during pre-pump, post-pump, post-breakup, and pre-freeze-up periods were measured.

Impacts to lake water levels would be minimized by natural recharge processes that occur primarily during spring break-up. Table 4A.2-3 presents estimates of recharge for the nine lakes studied by Michael Baker (2002e). The table also presents the volumes of water withdrawn from each pump lake and the difference between that volume and estimated recharge. The data indicate that all pump lakes received spring recharge in excess of winter withdrawal volumes. The estimated recharge and surplus volumes shown in the table did not account for the excess water that entered and subsequently exited the lake during the monitoring period. Thus, the reported recharge and surplus volumes are minimum amounts.

Impacts Associated with Water Withdrawals. Some general but appropriate broad-based conclusions regarding impacts associated with water withdrawal from lakes were found by the Michael Baker studies and were based on comparisons of results from their 2002 lake monitoring and recharge studies as well as from other studies, data, and information about the North Slope.

The Michael Baker (2002e) study concluded that water surface elevations decreased in most lakes between pre-pump and post-pump sampling events, and the water surface elevations in most pump lakes were lowered more than in reference lakes where no pumping was conducted. These water level changes in pump lakes were almost certainly the result of winter water withdrawal. However, the water surface elevations in all lakes increased to well above the pre-pump levels as a result of recharge (from snowmelt and snowmelt runoff) during spring break-up. Michael Baker (2002e) concluded that, without exception, pump lake recharge volumes were sufficient to compensate for winter water withdrawals. Further, water surface elevations in all lakes declined over the summer to levels below those measured during the pre-pump sampling event. These summer declines in water surface elevations were the result of lake-outflow and/or evaporation.

In general, most annual recharge to North Slope lakes occurs each year during spring break-up. Data from 2001 and 2002 lake studies and anecdotal information provided by seven North Slope communities indicates that the magnitude of spring recharge has always been sufficient to replace previously withdrawn water volumes (Michael Baker 2002e).

The results of the lake monitoring studies described above indicate that with prudent lake-level monitoring and adherence to pumping only permitted volumes, impacts to lake water levels are short-term. Continued monitoring programs should measure lake water levels through time and provide estimates of recharge and surplus volumes. These programs also should be integrated with assessments of impacts to lake habitat to determine if additional or more frequent monitoring is required and whether various stipulations that would decrease a permitted volume (that is, to a volume less than 15 percent) would be required.

TABLE 4A.2-2 2002 NPR-A LAKES WATER WITHDRAWAL VOLUMES

Lake	Location	Total Gallons Permitted	Pumped Volume in Gallons						Rank	Percent Used of Total Permitted
			Jan.	Feb.	Mar.	Apr.	May	Total		
R0052	Hunter	1,520,000	628,220	222,000	315,000	117,000	18,000	1,300,220	12	86
R0053	Hunter	24,000,000	9,000	0	0	0	0	9,000	16	0.04
R0054	Hunter	23,690,000	990,192	0	0	0	0	990,192	15	4
R0056	Hunter	339,670,000	3,426,474	444,000	330,000	0	0	4,200,474	5	1
L9911	Rendezvous	463,590,000	0	1,226,744	0	0	0	1,226,744	13	0.3
L9804	E.NPRA	106,860,000	87,990	2,441,376	0	0	0	2,529,366	8	2
L9806	E. NPRA	262,980,000	8,277,528	526,907	113,400	0	0	8,917,835	3	3
L9817	Peak Camp	72,150,000	2,400,696	10,330,410	3,444,060	1,115,106	0	17,290,272	1	24
M9602	Colville	415,900,000	2,479,428	358,971	0	0	0	2,838,402	7	0.7
M9605	Colville	238,300,000	3,336,228	303,450	1,687,350	1,001,700	56,700	6,385,428	4	3
M9606	Colville	3,900,000	476,322	596,232	0	0	0	1,072,554	14	28
M9912	Mitre	27,610,000	0	9,112,176	919,800	0	0	10,031,976	2	36
M9915	Rendezvous	23,360,000	0	297,360	1,158,780	0	0	1,456,140	10	6
M9922	Spark/Mitre	175,890,000	0	3,126,807	217,728	0	0	3,344,535	9	2
M9923	Spark/Mitre	175,890,000	0	3,126,807	217,728	0	0	3,344,535	6	2%
M0183	Puviaq	2,000,000	0	0	0	1,405,800	27,000	1,432,800	11	72
Total		**2,290,070,000**						**64,664,442**		**3**

Source: Michael Baker 2002e

TABLE 4A.2-3 WATER WITHDRAWAL AND SPRING RECHARGE VOLUMES

Water Surface Elevation (ft)					Lake Area[a] (acres)	Lake Volume[b] (mil gal)	Minimum Recharge Volume (mil gal)	Total Withdrawal[c] (mil gal)	Minimum Surplus Volume[d] (mil gal)
Lake	Post-Pump	Break-up	Post-Break-up	Recharged					
Pump Lakes									
L9911	68.35	68.67	--	0.32	540	464.6	56.3	1.2	55.1
M9912	40.64	41.63	--	0.99	33	27.6	10.6	10.0	0.6
M9922	49.88	50.83	--	0.95	191	108.6	59.1	1.6	57.5
L9923	57.44	--	57.96	0.52	252	175.9	42.7	3.3	39.4
L9817	53.98	--	54.96	0.98	75	72.2	23.9	17.3	6.6
Reference Lakes									
L9807	28.40	28.65	--	0.25	94	83	7.7	0.0	7.7
L9823	24.88	25.31	--	0.43	5	6.4	0.7	0.0	0.7
M0024	56.95	57.26	--	0.31	139	108.8	14.0	0.0	14.0
M9914	47.16	47.56	--	0.40	127	106.8	16.6	0.0	16.6

Source: Michael Baker 2002e

Notes:

[a] Data from MJM Research 2000b

[b] Based on water surface elevation changes

[c] January–May 2002. Data from PAI Extranet water use website (https://bizak.phillips66.com/water_use)

[d] Recharge and surplus volumes are considered minimum amounts, as these values do not include recharge volumes that flowed into and subsequently out of the lakes.

mil gal = million gallons

Potential Impacts Related to Roads and Pipelines. Natural drainage patterns can be disrupted when activities associated with road and pipeline construction block, divert, impede, or constrict flow in active stream channels, ephemeral or seasonal drainages, or shallow-water (overland) flow paths. Because construction of roads and pipelines will generally occur during the winter season, construction related impacts are negligible. The facilities would be constructed in accordance with designs that account for drainages and flow paths.

Impacts Associated with Pads. Natural drainage patterns can be disrupted when activities associated with pad construction block, divert, or impede flow during flooding episodes of active stream channels, ephemeral or seasonal drainages, or shallow-water (overland) flow paths. Because construction of pads will generally occur during the winter season, construction related impacts are negligible. The pads would be constructed in accordance with designs that account for drainages and flow paths.

Impacts to Estuaries and Nearshore Environment. Because the pad, road, and pipeline locations are not near the coast, no impacts to the physical conditions or processes within the estuarine and nearshore environment would be expected. Upstream of the coast, erosion and sediment transfer processes associated with the construction of pads and facilities would be controlled by appropriate best management practices (BMP), so impacts would not be likely to occur.

No substantial impacts to existing storm, wave, and erosion buffers are anticipated as a result of the proposed construction work.

Operations Period

Table 4A.2-4 summarizes potential operation impacts to satellite locations CD-3, CD-4, CD-5, CD-6, and CD-7 for each water resource

Impacts to Subsurface Water

The incremental volume of wastewater from the permanent worker housing at CD-1 would be injected, after pretreatment to meet existing permit requirements, into the approved Class II disposal wells at CD-1. There are no camps at the satellites during operations-only during construction and drilling. Class II disposal wells allow for the disposal of non-hazardous industrial wastes, domestic wastewater, storm water, and certain wastes that are exempt under specific federal regulations (that is, CFR 261(b)(5)). Approximately 2,000 to 3,000 gallons per day (or 2.3 to 3.4 ac-ft per year) of wastewater would be generated by pad operations. Since groundwater from these potentially affected zones would not be extracted and used for potable or construction and operation activities, no impacts are expected.

TABLE 4A.2-4 POTENTIAL OPERATIONAL IMPACTS TO WATER RESOURCES

Alternative A – CPAI Development Plan

Colville River Sub-Area	Groundwater		Lakes		Major and Minor Stream Crossings					Estuaries and Nearshore Environment	
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Ulamnigiaq Channel	Tamayagiaaq Channel	Sakoonang Channel	Colvville River	Minor Streams	Collville River Delta	Harrison Bay
CD-3 (CD-North)											
Gravel Road Segment: CD-3 to Airstrip	8	NI	NI	5	NI	NI	NI	NI	NI	7	NI
Ice Roads	NI	NI	NI	5	NI	NI	NI	NI	NI	6	NI
Airstrip	8	NI	NI	8	2,3	2,3	2,3	2,3	2,3	6	NI
Pipeline Segment: CD-1 - CD-3	NI	NI	NI	8	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	NI	3,4,5,6,7	6	NI
Production Pad	8	NI	NI	8	2,3	2,3	2,3	2,3	2,3	6	NI
Chemical/Petroleum Tank Storage	9	NI	9	9	NI	NI	NI	NI	NI	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	NI	NI	NI

CD-4 Area (CD-South)							
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Nigliq Channel	Minor Streams	Harrison Bay
Gravel Road Seg. CD-1 to CD-4	8	NI	NI	NI	NI	2,3,4,5,6	NI
Pipeline Segment: CD-1 - CD-4	NI	NI	NI	NI	NI	2,3,4,5,6	NI
Production Pad	8	NI	8	NI	NI	2,3,4,5,6	NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI

TABLE 4A.2-4 POTENTIAL OPERATIONAL IMPACTS TO WATER RESOURCES (cont'd)

Alternative A – CPAI Development Plan								
	Groundwater		Lakes		Major and Minor Stream Crossings			Estuaries and Nearshore Environment
CD-5								
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Nigliq Channel	Minor Streams		Harrison Bay
Gravel Road Segment: CD-2 -CD-5	8	NI	NI	NI	2,4,5,6	2,4,5,6		NI
Pipeline Segment: CD-2 -CD-5	NI	NI	NI	NI	NI	6		NI
Production Pad	8	NI	8	NI	NI	NI		NI
Bridges/Culverts	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7		NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	NI	9		9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI		NI
CD-6								
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish-Judy Creek Basin	Ublutuoch River Basin	Minor Streams	Harrison Bay
Gravel Road Segment: CD-5 - CD-6	8	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Pipeline Segment: CD-5 - CD-6	NI	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Production Pad	8	NI	8	NI	NI	NI	NI	NI
Bridges/Culverts	NI	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI

TABLE 4A.2-4 POTENTIAL OPERATIONAL IMPACTS TO WATER RESOURCES (cont'd)

Alternative A – CPAI Development Plan							
	Groundwater		**Lakes**		**Major and Minor Stream Crossings**		**Estuaries and Nearshore Environment**
CD-7							
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish-Judy Creek Basin	Minor Streams	Harrison Bay
Gravel Road Segment: CD-6 - CD-7	8	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Pipeline Segment: CD-6 - CD-7	NI	NI	NI	NI	2,3,4,5,6,7	2,3,4,5,6,7	NI
Production Pad	8	NI	8	NI	NI	NI	NI
Bridges/Culverts	NI	9	NI	NI	NI	2,3,4,5,6,7	NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI

Notes:

1 = Shoreline Disturbance & Thermokarsting
2 = Blockage of Natural Channel Drainage
3 = Increased stages & velocities of floodwater
4 = Increased channel scour
5 = Increased Bank Erosion
6 = Increased Sedimentation
7 = Increased potential for over banking (due to inundation or wind-generated wave run-up)
8 = Removal of surface soils/gravel and changes in recharge potential
9 = Chemical & Petroleum Spills & Cleanup
10 = Water Supply Demand
NI = No Impact

Impacts to Surface Water

Impacts Associated with Water Supply Demands. Lakes would supply fresh water for the periodic construction of ice roads and pads during the winter seasons during operations. The associated water demand would be comparable, on a per-mile of ice road basis, to the demand discussed under Construction Period above. These activities would have minor short-term (seasonal) impacts on water levels of small lakes and would have a negligible effect on larger deep lakes. Long-term effects on lake water levels are not expected because natural annual recharge processes are sufficient to fully recharge the lakes each year. Once construction and drilling are completed the overall water demand would be reduced because of fewer miles of ice roads, no mud plant operations except for occasional well workovers, no hydrostatic testing, and no temporary camps.

As indicated under Construction Period, the results of lake monitoring studies described above indicate that with prudent lake-level monitoring and adherence to pumping only permitted volumes, impacts to lake water levels are short-term. Continued monitoring programs should measure lake water levels through time and provide estimates of recharge and surplus volumes. These programs should also be integrated with assessments of impacts to lake habitat to determine if additional or more frequent monitoring is required and whether various stipulations that would decrease a permitted volume (that is, to a volume less than 15 percent) would be required.

Potential Impacts to Surface Water Conditions at Gravel Mines. Upon completion of gravel extraction activities from a mine site, the site will be rehabilitated. Rehabilitation could include knocking down any gravel piles to near tundra-grade and the development of a water reservoir suitable to support fish and wildlife habitats. In general, any new surface water bodies created by the mine pit excavation would be left to recharge naturally during high flows in natural streams and manmade channels during annual spring break-up floods. This process could be aided by placement of upwind snow fences or soil berms to accumulate windblown snow and speed filling in the water impoundments. There are no permits for a gravel quarry yet, but specific stipulations would outline desired rehabilitation goals for the site at the time of permitting.

Potential Impacts Related to Roads and Pipelines. Natural drainage patterns can be disrupted when activities associated with road and pipeline use block, divert, impede, or constrict flow in active stream channels, ephemeral or seasonal drainages, or shallow-water (overland) flow paths. The potential impacts occur during the operations period, but are best avoided by design considerations prior to construction. Blockage or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Constricting flows can result in increased stream velocities and a higher potential for ice jams, ice impacts, scour, and streambank erosion. Impeding flows can result in a higher potential for bank overflows and floodplain inundation. These effects can be minimized by incorporating design features to protect the structural integrity of the road- and pipeline-crossing structures from scour, ice jams, ice impacts, storm surges, and backwater effects from land-fast sea ice to accommodate all but the rarer flood events.

Scouring would be a particular concern because of its potential to affect the structural integrity of areas upstream and downstream of bridges and culverts. For each crossing, potential impacts would be evaluated and appropriate mitigation would be incorporated into the designs as necessary. For example, the bridge abutments and on-tundra aprons could be armored as necessary to protect the road and tundra from scour. If required, culvert inlets and outlets also would be armored as necessary. Appropriate slope protection consisting of fabric bags, armor rock, concrete articulated matting, revegetation, or other appropriate protection would be used where necessary. To protect the bridge from scour, the abutments would be armored and the piles would be set deep enough so that the structure would remain stable during the design scour event. Bridge structural design would account for the higher-magnitude and less frequent floods; slope-protection armor would protect against the more frequent, lower-magnitude floods. This approach should provide less obtrusive armor to protect against the highest-risk events and to minimize initial habitat impacts caused by armoring.

On the Colville River Delta, 80 percent of the proposed gravel road to CD-4 follows a naturally occurring topographic high that is essentially parallel to flows in the area but forms a barrier to frequent flood events. Less frequent, higher floods overtop this ridge. The remaining 20 percent of the proposed road would traverse relatively lower ground and form only discontinuous separation of the Nigliq and Sakoonang channels. This area is exposed to more frequent flooding, but because the road is still designed for 50-year return flood (plus 3 feet of freeboard), overtopping would be less likely.

Based on two-dimensional modeling and field observations (Michael Baker 2002b), flow across the proposed road is infrequent, localized, and has little or no apparent impact on the ground conditions, vegetation, and hydrologic regime between east and west side of the alignment. Recharge to the system east of the alignment is from the Sakoonang Channel, and recharge to the west of the alignment is from the Nigliq Channel.

The proposed pipeline corridor to CD-3 follows naturally occurring higher ground, crossing 450- to 750-foot-wide sections of the Ulamnigiaq, Tamayagiaq, and Sakoonang channels. The pipeline route to CD-5, CD-6, and CD-7 would have to cross eight drainages, including the 1,200-foot-wide bridge span on the Nigliq Channel. Pipeline bridges (box girder design) would be used only at major crossings, while large broadly spaced VSMs would be used for minor crossings. Therefore, impacts related to flow constriction would be unlikely at the minor crossings at all flows.

The alignment of the proposed gravel road to CD-5, CD-6, and CD-7 would cross the Nigliq Channel, the Ublutuoch River, and six other small drainages that drain to Fish Creek, and, ultimately, Harrison Bay. The alignment of the proposed pipeline would cross these same drainages but would follow a separate alignment 350 to 1,000 feet from the access road, except at the major bridge crossings, where pipelines would be collocated on the bridge structure.

In general, on the Delta and with the major stream or river crossings, pipeline-crossing structures are designed with more stringent standards than road-crossing structures because of the greater sensitivity of the environment to a structural failure. Pipeline-crossing structures are designed to accommodate the 200-year return flood (plus 1 foot of freeboard) while road-crossing structures (proposed road to CD-4 across the Colville River Delta channels) are designed to accommodate the 50-year return flood (plus 3 feet of freeboard). Except for the stream crossings, project roads elsewhere in the Plan Area (the proposed road from CD-5 to CD-6 and CD-7) could ultimately be designed using less stringent standards because they would not be in a flow environment.

At the major crossings, flow would be restricted at only the less frequent to rare high flows. During flow constriction, stream velocities increase, which could result in increased potential for scour and streambank erosion. The potential for these impacts would be reduced by appropriate mitigation incorporated into the bridge designs. Pipeline bridges would be designed to be above the 200-year recurrence interval floodwater surface elevation plus 1 foot of freeboard. The VSMs supporting the pipelines would be designed to withstand ice forces and scour associated with a 200-year recurrence interval flood event.

In the rare event that the design floods are exceeded on the Delta, natural delta topography and man-made facilities would slow the flood flows, which would result in widespread inundation and sedimentation across much of the Delta. At this time, flow constrictions would still occur at the main channel crossings and increase the potential for localized scouring of crossing structures and erosion of bridge abutment foundations and road embankments.

Potential Impacts Associated with Pads. Natural drainage patterns can be disrupted when activities associated with pad construction and use block, divert, or impede flow during flooding episodes of active stream channels, ephemeral or seasonal drainages, or shallow-water (overland) flow paths. The potential impacts occur during the operations period, but are best avoided by design considerations prior to construction. Blockage or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Impeding flows can result in a higher potential for bank overflows and floodplain inundation. These effects are minimized by incorporating construction mitigation and design features into the pads to protect the structural integrity of the pads and minimize the effects of pads on natural flow processes.

Design criteria for CD-3, CD-4, CD-5, CD-6, and CD-7 will eliminate or minimize the potential for impacts to these facilities and potential impacts from pad development. These criteria, described in Section 2, include more stringent design features for those facilities on the Delta (CD-3 and CD-4) than those on the coastal plain.

Because the proposed location of the CD-3 production pad is between West Ulamnigiaq and East Ulamnigiaq channels on the Delta, it is an area where rare but high-magnitude flood events can potentially occur. Thus, to minimize potential impacts during these high flows, the pad would be situated on the highest terrain in the area. Further, the proposed pad location also is adjacent to the southwest end of a small lake (M9313). However, the pad would not affect fish passage to Lake M9313 because the site is situated away from the primary route of fish passage. Potential impacts associated with aboveground storage tanks placed at CD-3 would occur during very high flood events that overtopped the secondary containment. Design criteria specify protection for up to the 200-year event, so impacts are not likely.

The location and placement of the proposed CD-4 pad is not expected to change the hydrologic regime significantly in the area. The proposed minimum pad elevation would be at least 3 feet above the 200-year flood water surface elevation, and water velocities during the 200-year flood are likely to be relatively slow (on the order of 1 foot to 2.5 feet per second) on the floodplain near the proposed facility. Further, based on the results of the preliminary analyses conducted by Michael Baker (2002b), storm surge would not produce a higher water surface elevation than a river flood with a similar risk of occurrence.

At CD-4, the structure and function of low-lying, high-value wetlands has been evaluated and would be maintained because the access road has been situated on high ground that would not be expected to affect flow associated with a 5-year flood event. Fish passage to Lake L9323 from the Nigliq Channel and from the Sakoonang Channel (via Lake L9324 and M9525) would be maintained by routing the road across the center constriction of the lake and maintaining floodwater paths from both the east and west. A culvert would be provided as part of the lake crossing to allow free movement of fish in the lake.

The CD-5 satellite location is more than 1 mile from the nearest lake or stream and on relatively flat ground, so impacts to surface water are unlikely.

The CD-6 satellite location is also on relatively flat ground along a small topographic divide, but within the 3-mile no permanent facilities stipulation (CPAI). Depending on where the measurement is taken, the proposed pad is about 1.3 to 2 miles from Fish Creek, about 1,800 feet from a small unnamed tributary to Fish Creek, and about 2,600 feet from a small lake. Other than these water bodies, no other water bodies are within a half-mile of the facility, so impacts to surface water from this facility are unlikely.

CD-7 would be approximately 8.5 miles southwest of CD-6 and south of the 3-mile no permanent facilities stipulation. It is located more than a half-mile southwest of an area with many moderate-sized and small lakes. However, it is within a drained lake basin, suggesting that during periods of high water in spring and fall, waters near the pad would flow into downstream lakes and ultimately into Fish Creek. Future monitoring of water-level conditions and flow paths during spring break-up in the drained lake basin is needed to ascertain the potential risks to the CD-7 pad and downstream waters.

Break-up typically occurs as a flood event and, combined with ice and snow damming, can flood large areas of the tundra. Thus, even though the proposed pad locations for CD-5, CD-6, and CD-7 are relatively remote from streams, potential impacts associated with spring break-up have been incorporated into the pad designs.

Impacts to Estuaries and Nearshore Environment

Because the pad, road, and pipeline locations are not near the coast, no impacts to the physical conditions or processes within the estuarine and nearshore environment would be expected.

However, storm surges and wave action could affect the operation of some of the proposed facilities. Storm surges from Harrison Bay (extreme high tidal regimes produced by sustained westerly winds during the summer open-water months) can bring seawater flooding inland from the Delta front. Support for historic storm surges is evident in driftwood lines that are found a number of miles from the coast. While it is conceivable that storm surge waters could reach as far inland as CD-3, such occurrences would be infrequent and likely would not produce any serious flooding impacts.

Impacts Associated With Ice Conditions

Pipeline and road bridges and road culverts can cause flow constrictions during flood events, which can exert extraordinary stresses on structures. The build-up and impact of ice, especially during the larger-magnitude floods, exacerbate this condition. Bridge and culvert designs will need to consider ice build-up and ice forces to reduce the potential for impacts that would include increased stresses on bridge abutments, increased scouring of bridge supports, increased side slope erosion, and overbank flows onto roads, as well as fish passage at times of increased flow.

The potential effects on proposed gravel structures, culverts, bridges, and pipelines from changes to the hydraulic regime associated with break-up could occur from increased flood stages and velocities, increased potential for overtopping (from wave run-up), and side-slope erosion. The structural integrity of the proposed facilities can be maintained by conservative estimation of design flood conditions to avoid overtopping, evaluation of the erosion potential and run-up of wind-driven waves, evaluation of ice forces on pipeline VSMs and gravel structures, and designing adequate side-slope protection.

The likelihood of failure of pipeline, road, and facility structures associated with ice conditions is minimized by conservative designs. Continued monitoring of these structures during development of previous Alpine facilities has provided input to improve design. The continued incorporation of design improvements based on this monitoring suggests that potential impacts from ice conditions are not likely to occur.

Alternative A – Full-Field Development Plan Impacts on Water Resources

The various hypothetical facilities of the FFD are distributed throughout the Northeast NPR-A area and the Colville River Delta, and, as a consequence, roads and pipelines would cross many drainages within the Colville River, Fish-Judy Creeks, and the Kalikpik-Kogru Rivers facility groups, and production pads could be located adjacent to lakes and stream channels. The impact analysis for the FFD is conceptually no different from the proposed project, except that area covered is much larger. This means that the impacts and design features described above for the proposed CPAI Development Plan will be relevant here. Table 4A.2-5 summarizes potential construction and operation impacts to water resources from the hypothetical 22 production pads and two processing locations of the FFD.

Alternative A – Summary of Impacts (CPAI and FFD) on Water Resources

Impacts to Subsurface Waters

Specific localized deep groundwater zones could be affected by the practice of disposing of drilling wastes and wastewater into development or disposal wells; however, because groundwater below permafrost is typically saline, impacts to potable water sources are not expected.

Although very local in extent, shallow thawed water-bearing zones could be enlarged or eliminated during the construction, operation, and rehabilitation of any gravel mine. Although rehabilitation would include allowing natural flows to fill the mine site excavation, the subsurface water-bearing zone would be permanently eliminated.

In the FFD scenario, as in the proposed CPAI Development Plan, specific localized deep groundwater zones could be adversely affected by the practice of disposing of drilling wastes and wastewater into development or disposal wells. Although this practice would affect more groundwater zones throughout the FFD area, because groundwater below permafrost is typically saline, impacts to potable water sources are not expected. The FFD would require additional gravel quarries to be mined. As described above for the proposed CPAI Development Plan, each new gravel mine would eliminate local subsurface water-bearing zones; however, the effect of this loss on water resources would be negligible.

TABLE 4A.2-5 POTENTIAL CONSTRUCTION AND OPERATIONAL IMPACTS TO WATER RESOURCES

Alternative A - Full Field Development														
Colville River Sub-Area	Groundwater		Lakes		Major and Minor Stream Crossings								Estuaries and Nearshore Environment	
	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Nigliq Channel	Sakoonang Channel	Tamayagiaaq Channel	Ulamnigiaq Channel	Elaktoveach Channel	Kupigruak Channel	Colvville River	Minor Streams	Collville River Delta	Harrison Bay
Hypothetical production pads CD-11, 12, 14, 15, 19, 20, and 21														
<u>Gravel Road Segments</u>: CD-4 to CD-11; CD-2 to CD-12; CD-14 road to airstrip; CD-19 road to airstrip; CD-20 road to airstrip; CD-21 road to airstrip	8	NI	NI	NI	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7	NI
<u>Ice Roads</u>: CD-14, 19, 20, and 21	NI	NI	NI	NI	NI	NI	3	3	3	3	3	3	1,2,3,4,5,6,7	NI
<u>Pipeline Segment</u>: CD-11 to CD-4;CD-12 to CD-2;CD-14 to CD-3/1 pipeline;CD-19 to CD-14;CD-20 to CD-19;CD-21 to CD-19	NI	NI	NI	NI	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	3,4,5,6,7	1,2,3,4,5,6,7	NI
<u>Production Pads</u>: All Hypothetical Satellite Locations	8	NI	8	8	2,3	2,3	2,3	2,3	2,3	2,3	NI	2,3	2,3	NI
<u>Airstrips</u>: CD-14, 19, 20, and 21	8	NI	8	8	2,3	2,3	2,3	2,3	2,3	2,3	NI	2,3	2,3	NI
Underground Injection	NI	9	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Chemical/Petroleum Tank Storage	9	NI	9	9	9	9	9	9	9	9	9	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI

TABLE 4A.2-5 POTENTIAL CONSTRUCTION AND OPERATIONAL IMPACTS TO WATER RESOURCES (cont'd)

Alternative A - Full Field Development										
Fish and Judy Creeks Sub-Area	Shallow groundwater	Deep Groundwater	Small Shallow Lakes and Ponds	Large Deep Lakes	Fish Creek Basin	Inigok Creek Basin	Judy Creek Basin	Ublutuoch River Basin	Minor Streams	Harrison Bay
Hypothetical processing facility APF-2, and hypothetical production pads CD-8, 9, 10, 13, 16, 17, 18, 22, 23, 24, and 26										
Gravel Road Segments: CD-8 to CD-6/5;CD-7 to CD-9;CD-10 to CD-6/5;CD-13 to CD-5/6 ; CD-13 to CD-16; CD-17 to CD-7/9 ;CD-16 to CD-18; CD-6 to CD-22;APF-2 to CD23;CD-23 to CD-24;CD-24 to CD-26	8	NI	3,5,6,7	3,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	NI
Pipeline Segment: CD-8 to CD-6/5 ;CD-7 to CD-9;CD-10 to CD-6/5;CD-13 to CD-5/6 ; CD-13 to CD-16; CD-17 to CD-7/9 ;CD-16 to CD-18; CD-6 to CD-22;APF-2 to CD23;CD-23 to CD-24;CD-24 to CD-26	NI	NI	3,5,6,7	3,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	2,3,4,5,6,7	NI
Production Pads Hypothetical Satellite Locations and Hypothetical Processing Facility	8	NI	8	NI	2,3	2,3	2,3	2,3	2,3	NI
Underground Injection	NI	9	NI	NI	NI	NI	NI	NI	NI	NI
Processing Facility: APF-2	8	NI	NI	NI	NI	NI	2,3,4,5,6	NI	NI	NI
Chemical/Petroleum Tank Storage	9	NI	9	9	9	9	9	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI	NI	NI

TABLE 4A.2-5 POTENTIAL CONSTRUCTION AND OPERATIONAL IMPACTS TO WATER RESOURCES (cont'd)

Alternative A - Full Field Development								
Kogru-Kalikpik Sub-Area	Shallow Groundwater	Deep Groundwater	Small Shallow Lakes & Ponds	Large Deep Lakes	Kalikpik River Drainage	Kogru River	Minor Streams	Harrison Bay
Hypothetical processing facility APF-3 and hypothetical production pads CD-25, 27, 28, and 29								
Gravel Road Segments: CD-25 to APF-2;CD-27 to APF-3/CD-25 road;CD-28 to APF-3;CD-29 road to airstrip; APF3 to CD-25;APF-3 road to airstrip	8	NI	3,5,6	3,5,6	2,3,4,5,6	NI	2,3,4,5,6	NI
Ice Roads: CD-29	NI	NI	NI	NI	NI	3,4,5,6,	3,4,5,6,	3,4,5,6,
Pipeline Segment: CD-25 to APF-2;CD-27 to APF-3/CD-25 road;CD-28 to APF-3;CD-29 to CD-28; APF-3 to CD-25	NI	NI	NI	NI	2,3,4,5,6	2,3,4,5,6	2,3,4,5,6	NI
Production Pads: All hypothetical Satellite Locations and hypothetical processing facility	8	NI	NI	NI	2,3,4,5,6	2,3,4,5,6	2,3,4,5,6	NI
Airstrips: CD-29, APF-3	8	NI	NI	NI	3,4,5,6	3,4,5,6,7	3,4,5,6,7	NI
Underground Injection	NI	9	NI	NI	NI	NI	NI	NI
Processing Facility: APF-3	8	NI	NI	NI	3,4,5,6	NI	NI	NI
Chemical/Petroleum Tank Storage	9	NI	9	NI	9	9	9	9
Surfacewater extraction for potable and construction use	NI	NI	10	10	NI	NI	NI	NI

Notes:

1 = Shoreline Disturbance & Thermokarsting

2 = Blockage of Natural Channel Drainage

3 = Increased stages & velocities of floodwater

4 = Increased channel scour

5 = Increased Bank Erosion

6 = Increased Sedimentation

7 = Increased potential for over banking (due to inundation or wind-generated wave run-up)

8 = Removal of surface soils/gravel and changes in recharge potential

9 = Chemical & Petroleum Spills & Cleanup

10 = Water Supply Demand

NI =No Impact

Impacts to Surface Waters Associated with Water Supply Demands

Adequate monitoring and adherence to pumping regulations would limit impacts to lake-water levels to short-term duration. Future monitoring programs should continue to measure lake-water levels through time and provide estimates of recharge and surplus volumes. These programs should also be integrated with assessments of impacts to lake habitat to determine if additional or more frequent monitoring is required and whether various stipulations that would decrease a permitted volume (that is, to a volume less than 15 percent) is required. In general, impacts on lake-water levels are not expected because natural annual recharge processes are sufficient to fully recharge the lakes each year.

Demands of FFD on the water supply would be approximately four to five times that associated with the proposed plan. These demands would be dispersed over time and across a broad area where there are abundant lakes; therefore, impacts are not expected to be any greater than for the CPAI Development Plan. Lakes would still be the principal freshwater supply for the construction of ice roads and pads during the winter seasons, during production drilling and processing operations, and for potable water at temporary construction or drilling camp facilities. In general, impacts on lake-water levels are not expected because natural annual recharge processes are sufficient to fully recharge the lakes each year.

Future monitoring programs should be developed for specific representative areas within the FFD Plan Area. These programs should develop strategies to measure lake-water levels through time and provide estimates of recharge and surplus volumes. These programs should also be integrated with assessments of impacts to lake habitat.

Impacts to Surface Water Conditions at Gravel Mines

Small lakes suitable to support fish and wildlife habitats could be created as a result of gravel extraction activities. In general, any new surface water bodies created by mine pit excavation would be left to recharge naturally during high flows in natural streams and manmade channels during annual spring break-up floods. As described in Section 4A.3.3, impacts would be mitigated by providing for appropriate fish passage (for example, during spring flows) into and out of these small lakes to nearby water bodies and/or the maintenance of a lake deep enough for over-wintering.

Impacts to Rivers and Creeks Related to Roads and Pipelines

Rivers and creeks can be affected when construction and operation activities associated with road and pipelines block, divert, impede, or constrict flows. Blockage or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Constricting flows can result in increased stream velocities and a higher potential for ice jams, ice impacts, scour, and streambank erosion. Impeding flows can result in a higher potential for bank overflows and floodplain inundation. These potential impacts have been minimized by incorporating design features to protect the structural integrity of the road- and pipeline-crossing structures to accommodate all but the rarer flood events.

In general, on the Delta and for the major stream or river crossings, pipeline-crossing structures are designed with more stringent standards than road-crossing structures because of the greater sensitivity of the environment to a structural failure. Pipeline-crossing structures are designed to accommodate the 200-year return flood (plus 1 foot of freeboard), while road-crossing structures are designed to accommodate the 50-year return flood (plus 3 feet of freeboard).

In the rare event that the design floods are exceeded, it is likely that natural delta topography and manmade facilities would slow the flood flows, which would result in widespread inundation and sedimentation across much of the Delta. At this time, flow constrictions and high velocities would still occur at the main channel road and pipeline crossings and increase the potential for localized scouring of crossing structures and erosion of bridge abutment foundations and road embankments.

In the FFD scenario, roads and pipelines would cross numerous rivers and creeks, and production pads could be situated in locations adjacent to lakes, streams, and rivers. These structures would affect surface waters when construction and operation activities block, divert, impede, or constrict flows. In general, existing data, information, and studies conducted in the areas of the Colville River and Fish-Judy Creeks facility groups can be applied to developing appropriate mitigation and design elements for road and pipeline crossings and production pads, and the impact analysis described above is relevant here. Very little data and information are available, however, for streams in the Kalikpik-Kogru Rivers Facility Group. In any case, future monitoring programs would need to be developed for representative locations throughout the FFD area to help develop appropriate design and mitigation strategies. Further, potential impacts would be minimized by incorporating design features that protect the structural integrity of the road- and pipeline-crossing structures to accommodate all but the rarer flood events.

In general, for those roads and pipelines serving the seven production pads in the Colville River Delta Facility Group on the Delta, potential impacts would be greater, so design criteria are more stringent. Further, because there is a greater sensitivity of the environment to a structural failure of pipelines, more care will be necessary to locate pipeline crossings. In the rare events when design floods are exceeded, the potential impacts associated with FFD would be greater than for the CPAI Development Plan, simply because there are more structures and facilities at risk.

Impacts to Surface Waters Related to Production Pads

Various features and criteria have been incorporated into the designs for each production pad (CD-3, CD-4, CD-5, CD-6, and CD-7) to eliminate or minimize the potential for impacts to and from surface waters. These criteria are more stringent for those facilities on the Delta (that is, 200-year flood event for CD-3 and CD-4) than those on the coastal plain (a 50-year flood event for CD-5, CD-6, and CD-7), which are not close to creeks or lakes. CD-7, however, is in a drained lake basin, which suggests that during high-water periods water could accumulate near the pad and eventually flow into downstream lakes and ultimately into Fish Creek. Future monitoring of water-level conditions and flow paths in the drained lake basin is needed to ascertain the potential risks to the CD-7 pad and downstream waters.

Impacts to Estuaries and Nearshore Environment

Because the pad, road, and pipeline locations are not near the coast, no impacts to the physical conditions or processes within the estuarine and nearshore environment are expected.

Except for one hypothetical production pad in the Kalikpik-Kogru Rivers Facility Group (CD-29), all the production pads and access roads of the FFD would be located at least 3 miles from the coast. Because the pad, road, and pipeline locations would not be near the coast, no impacts to the physical conditions or processes within the estuarine and nearshore environment would be expected. The site of CD-29 appears to be on relatively high ground between two thaw lakes approximately 1,500 feet from an actively eroding coastline. This indicates that appropriate monitoring of coastal processes is warranted to locate and design for any potential access road, pipeline, or production pad in this area.

Impacts Associated with Ice Conditions

For both the CPAI Development Plan and the FFD scenarios, the likelihood of failure of pipeline, road, and facility structures associated with ice conditions is possible but minimized considerably by conservative designs. Monitoring of these structures during development of previous Alpine facilities continues to provide input to mitigation design features. The continued incorporation of design improvements based on this monitoring suggests that potential impacts from ice conditions are not likely to occur.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Water Resources

No additional measures have been identified to mitigate impacts to water resources under Alternative A or Alternative A FFD.

4A.2.1.2 Surface Water Quality

Alternative A – CPAI Development Plan Impacts on Surface Water Quality

Construction Period

NPDES Discharge

Temporary camps could be used at each production pad during construction and drilling operations. Most sewage and all solid waste would be transported to CD-1 for disposal with systems in place at CD-1. However, discharges of treated domestic wastewater to tundra could occur in accordance with the NPDES permit (AKG-33-0000) requirements. Specific limitations in the draft NPDES permit include: $6.5<pH<8.5$; no film, sheen or discoloration on recessing water surface; no floating solids, foams, or garbage; no discharge of kitchen oils; and quantitative limitations on flow, biochemical oxygen demand, total suspended solids, fecal coliform, and total residual chlorine. Discharges to tundra wetlands require development of a BMP plan to address prevention of chlorine burn and excessive nutrients and/or sediment loading of the tundra. These conditions support the conclusion that no measurable, non-localized impacts to water quality from activities performed in compliance with the NPDES permits would be expected.

Water Withdrawal from Lakes

Fresh water would be withdrawn from lakes within the ASDP area for three different uses: (1) construction of ice roads and pads during the winter construction season; (2) production drilling; and (3) potable water at the project camp facilities (CD-1) and temporary construction and drilling camps. Ice road construction would require approximately 1 million gallons of water for each mile of road built. The drilling program would require 38,000 gallons of water per day to support drill rig and mud plant operations at each satellite location (CPAI 2003). The drilling mud would be mixed at CD-1, so water would be withdrawn from lakes near CD-1, not at the individual satellites. In addition, approximately 5,000 gallons per day of potable water would be used by the rig camp operations. Water withdrawal from lakes would gradually lower the water levels throughout each winter and during the drilling in the summer months each year. However, naturally occurring recharge in the spring would be expected to fully replace—and under certain conditions even exceed—the withdrawn water volumes in the lakes (Michael Baker 2002). Permit conditions for water withdrawal would govern which lakes could be used, the quantities that could be withdrawn, and the monitoring that must be performed.

Lakes in the Plan Area that would be used for water withdrawal could be tapped lakes or perched lakes that are recharged by periodic flood events or by snowmelt and runoff each spring (Michael Baker 2002). Water withdrawal in the winter would potentially alter lake-water chemistry temporarily by oxygen depletion and ion concentration (see discussion following in the sections on Alkalinity and pH and Oxygen) (URS Corporation 2001). However, permit conditions governing water withdrawals would be written to prevent any degradation of water quality during the winter months that would compromise fish habitats. Because multiple permitted lakes are available as supplemental water supply, degradation at individual locations could be mitigated through use of alternate sources. Oxygen depletion and oil concentration effects would be expected to disappear after spring recharge and ice melting.

Erosion and Sedimentation

Alterations in surface drainage patterns from construction of roads, pads, and airstrips could affect both water levels and water quality in adjacent wetlands and streams. Culverts, berms, and undersized bridges tend to concentrate flows that would otherwise disperse over a wider area. Concentrated flows are more likely to erode ice-rich soils and, consequently, could increase turbidity and sediment deposition within small drainage areas adjacent to roads, bridges, and other facilities.

Potability

Surface water bodies in the Plan Area do not meet potable water standards without treatment. CPAI would be allowed to discharge domestic (sewage and gray water) effluents, but only in compliance with conditions specified in the NPDES permit. Discharges could occur at temporary camps at each drill site. No discharge of sewage directly to water bodies in the Plan Area by industry would occur. Therefore, no increase in fecal coliform counts over the naturally occurring concentrations would be anticipated.

Turbidity

Where gravel fill is used to construct the road, pad, or airstrip in wet areas, the receiving waters could temporarily have higher suspended solids concentrations and greater turbidity. However, since gravel fill construction would take place in winter, impacts on water quality would be limited to the entrainment of fine-grained fill material in runoff from the facilities during the spring thaw and/or during precipitation events during the summer following construction.

The primary effect on water quality from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion (Walker et al. 1987). Thermokarst erosion, partially caused by tundra disturbance and partly by the thermal effect of dust blown off the gravel onto the tundra, can result in water features with high turbidity and suspended-sediment concentrations. Thermokarst erosion could cause the state turbidity standard to be exceeded within and downflow of thermokarst features. In flat, thaw-lake plains on the North Slope, gravel construction could result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or approximately 450 acres for the development assumptions made in this alternative for the applicant's proposed project.

Dust fallout from vehicle traffic could increase turbidity within ponds and lakes adjacent to roads and construction areas in the Plan Area. Algae productivity also could increase from nutrients entering the water with the dust. Depending on the average size of the airborne particles, prevailing wind direction, and wind speed, dust fallout would typically occur within 330 feet of the activity (USACE 1980). However, because construction and most vehicular traffic associated with the proposed action would occur during winter, any adverse impacts on water quality from dust should be minimal.

No impact to water quality from winter water extraction from lakes would be expected. Turbidity increased similarly in both pumped and unpumped lakes in 2002 monitoring (Michael Baker 2002).

Alkalinity and pH

As surface waters freeze, salts are extruded from the forming ice into the underlying water, increasing salinity. In coastal tundra waters, the alkalinity is associated with the salt content, and increases and decreases in alkalinity parallel those of salinity. Pumping water from a lake in the winter would remove the relatively more saline and more alkaline water from under the lake ice. During snowmelt in the spring, less saline, less alkaline runoff water would replace the removed waters. In lakes less than 6 feet deep, which freeze to the bottom, the salts normally would be frozen out of the entire water column and extruded into the sediment thaw bulb underlying the lake. These salts then slowly and partially leach back into the water column the following summer. For such lakes, the early summer condition would be relatively low salinity, low alkalinity water, regardless of whether or not water was removed for ice-road construction. Based on observed lake pH, these lakes are weakly, but still apparently adequately, buffered against acid snowmelt.

In lakes greater than 6 feet deep, the salts and alkalinity excluded from ice formation normally would remain in the unfrozen bottom water. These lakes start the summer with more saline, relatively strongly buffered (against acid snowmelt) waters underneath the melting ice. Winter removal of more saline water underneath the ice would result in less saline, less buffered lake waters in early summer following winter water extraction. Thus, following winter extraction of water, their early summer chemistry would be more similar to that of lakes less than 6 feet deep. However, lake monitoring studies performed in conjunction with water withdrawal for NPR-A exploration activities showed no measurable difference in salt content for water in pumped versus reference lakes (URS Corporation 2001). Measurements of pH values for pumped and unpumped lakes in 2002 increased by 1.43 and 1.52 units, respectively (Michael Baker 2002). Values of pH similarly increased in previous investigations (URS Corporation 2001). No measurements of alkalinity were reported in recent lake studies in the Plan Area.

Another way that ice-road construction could affect water quality would be through changes in water chemistry along the roadbed during and after meltout. As described above, the water withdrawn from lakes to construct the roadway is relatively more saline than typical snowmelt waters. In addition, the salts frozen into the ice road would leach out of the ice before it melts during snowmelt, increasing initial salt content of the meltwater. This effect could potentially occur during initial snowmelt, but the effect on water quality should be localized, most likely expressed as a slight buffering of pH during initial snowmelt.

Use of water for construction, drilling, and domestic (crew) needs could affect water quality, as discussed for ice-road construction. Effects during construction and drilling on water quality from any of these mechanisms would be short term, lasting generally one season.

Annual ice-road construction could cover between 20 and 350 acres during each year of construction for the CPAI Development Plan. This ice-road construction, as well as drilling needs, would require winter extraction of water that would affect up to 300 ac-ft of nearby intermediate-depth (6 foot) lakes. The affected areas of the ice-road footprint would change each year because the ice roads would be shifted over one road width within the NPR-A to avoid continued compaction of vegetation. Temporary upslope impoundment of snowmelt waters could cover areas parallel to ice road construction for a few days each spring, but without measurable effect on water quality.

Oxygen

Ice-road construction over lakes deep enough not to freeze to the bottom could affect dissolved oxygen concentrations. Many of these lakes are just a foot to a few feet deeper than the minimum 6-foot depth necessary to maintain some unfrozen bottom water in winter. An ice road across such an intermediate-depth lake would be designed to freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen could result. Dissolved oxygen concentrations could be reduced below the 5-ppm dissolved oxygen standard needed to protect resident fish (ADEC 2003b). However, in 2002, dissolved oxygen levels in pumped lakes were nearly three times the average concentration of the reference lakes. Higher levels of oxygenation in pumped lakes could have been a result of circulating water used to keep the hole open in the ice (Michael Baker 2002).

Estuarine Waters and Water Quality

No construction, disturbance, or discharges would occur in estuarine areas for the CPAI Development Plan. Because almost all of the yearly flow of rivers on the North Slope occurs in the short spring and summer periods, there is a great seasonal difference for suspended sediment flow regimes. During high flow periods, streams often carry highly turbid water toward the ocean and deposit sediments in low-velocity locations within the floodplain, such as deltas or overbank areas. The naturally high turbidity of estuarine waters during high flow levels would show no measurable increase in suspended sediments attributable to activities associated with the applicant's proposed action. During times of lower flow levels, turbidity of entering rivers would be lower, but no project-related increases in river turbidity would be expected. The project-related actions that would result in increased suspended sediment inland to rivers, and thereafter to estuarine water, from erosion or sedimentation would occur only during the spring and summer when the water flow is high and the increase in estuarine water turbidity would not be measurable.

Marine Water Quality

No measurable degradation of marine water quality would result from the applicant's proposed construction activities.

Operation Period

Impacts to surface water quality from potential spills are not presented here, but rather in Section 4.3. Water quality impacts potentially resulting from proposed construction, drilling, operations, and abandonment activities are described in this section. Potentially affected water resources include the Colville River and its distributaries, other rivers and streams in the planning area (for example, Fish Creek, Judy Creek, Ublutuoch River), Harrison Bay, and lakes and ponds. The primary beneficial uses for these unimpaired, high-quality surface waters are growth and propagation of fish and wildlife.

NPDES Discharges

Discharges of treated wastewater could occur to tundra in accordance with NPDES permit requirements. For the applicant's proposed action, very little wastewater would be generated at the five production pads after construction and drilling are complete because all personnel would be lodged and based at the existing camp at CD-1. Temporary camps could be used at each production pad during drilling operations. All sewage and solid waste would be transported to CD-1 for disposal with the systems in place at CD-1. No measurable, non-localized impacts to water quality from activities performed in compliance with the NPDES permit would be expected.

Water Withdrawal from Lakes

Fresh water would not be withdrawn from lakes within the ASDP Area during the operation period.

Erosion and Sedimentation

Continued alterations in surface drainage patterns after construction of roads, pads, and airstrips could affect both water levels and water quality in adjacent wetlands and streams.

Potability

No discharge of sewage directly to water bodies in the Plan Area by industry would occur during operations. Therefore, no increase in fecal coliform counts over the naturally occurring concentrations would be anticipated.

Turbidity

Once construction is completed, the gravel roads between pads or connecting pads to airstrips and the gravel pads would be the only, but potentially large, dust source from the proposed action. Dust fallout from vehicle traffic could increase turbidity within ponds and lakes adjacent to roads and construction areas in the Plan Area.

Alkalinity, pH, Oxygen

No impacts to the alkalinity, pH, or oxygen content of water in the ASDP Area would occur during operations.

Estuarine Waters and Water Quality

Water quality impacts described above for fresh water would generally be the same for estuarine waters. However, increased salinity and lower turbidity of estuarine waters compared to inland lakes and rivers would result in some differences in expected impacts. No construction, disturbance, or discharges would occur in estuarine areas for the CPAI Development Plan or for FFD. However, accidental spills reaching rivers and estuarine waters and activities causing increased sediment in rivers would be two possible sources of impacts to estuarine water quality. Oil spills impacts are described in Section 4.4, and spills of miscellaneous fluids would not be expected to be of sufficient size to reach estuarine waters. A salt-water spill from a pipeline flowing to an individual satellite would be the most likely scenario for an accidental release reaching estuarine waters. However, the higher salinity (approaching marine water salinity) of these waters in comparison to inland water bodies would prevent measurement of any change in salinity in estuarine water. The most detrimental impact to estuarine water quality from a sea-water spill would be from the biocides or other chemicals added during treatment before flow to the satellites.

Because almost all of the yearly flow of rivers on the North Slope occurs in the short spring and summer periods, there is a great seasonal difference for suspended sediment flow regimes. During high flow periods, streams often carry highly turbid water toward the ocean and deposit sediments in low-velocity locations within the floodplain, such as deltas or overbank areas. The naturally high turbidity of estuarine waters during high flow levels would show no measurable increase in suspended sediments attributable to activities associated with the applicant's proposed action. During times of lower flow levels, turbidity of entering rivers would be lower, but no project-related increases in river turbidity should occur. The project-related actions that would result in increased suspended sediment inland to rivers, and thereafter to estuarine water, from erosion or sedimentation would only occur during spring and summer when the water flow is high and the increase in estuarine water turbidity would not be measurable.

Marine Water Quality

With the exception of a potential oil spill transported by river flow to Harrison Bay and the Beaufort Sea, no measurable degradation of marine water quality would result from the CPAI Development Plan or the FFD scenario. Impacts to marine water quality from potential oil spills are presented in Section 4.3.

Alternative A – Full-Field Development Plan Impacts on Surface Water Quality

Impacts to water quality from the FFD scenario would be the same as those discussed above for the CPAI Development Plan except for those described in the following sections.

<u>Construction and Operation Periods</u>

Impacts during construction and operation periods would be similar and are discussed together.

NPDES Discharges

For the FFD scenario, all sewage and solid waste would be disposed of at APF-2 and APF-3 by injection to the subsurface in a manner analogous to that used at CD-1. Wastewater discharges to tundra at individual pads could be performed under the General NPDES Permit for Oil and Gas Extraction on the North Slope of the Brooks Range, permit number AKG 330000. The NPDES permit covers gravel pit dewatering, storm water, and domestic wastewater from temporary camps. The pollutant content of the permitted discharges would be regulated through monitoring of permit conditions as issued by the USEPA. Monitoring is required as a condition of the permit to ensure that discharges do not exceed water quality standards, are not toxic to organisms in receiving waters, do not degrade water quality, and do not pose a threat to human health. Thus, no measurable, non-localized impacts to water quality from activities performed in compliance with the NPDES permit would be expected.

Water Withdrawal from Lakes

Fresh water would be withdrawn from lakes within the ASDP Area for three different uses:

- Construction of ice roads and pads during the winter construction season
- Production drilling and processing operations
- Potable water at the project camp facilities (CD-1, APF-2, and APF-3) and temporary construction and drilling camps.

Ice road construction would require approximately 1 million gallons of water for each mile of road built. The drilling program would require 38,000 gallons of water per day to support drill rig and mud plant operations at each satellite location (CPAI 2003). The drilling mud would be mixed at CD-1, so water would be withdrawn from lakes near CD-1, not at the individual satellites. In addition, approximately 5,000 gallons per day of potable water would be used by the rig camp operations. Water withdrawal from lakes would gradually lower water levels throughout each winter and during the drilling in the summer months each year. However, naturally occurring recharge in the spring would be expected to fully replace, and under certain conditions even exceed, the withdrawn water volumes in the lakes (Michael Baker 2002). Permit conditions for water withdrawal would govern which lakes could be used, the quantities that could be withdrawn, and the monitoring that must be performed.

- Turbidity

Where gravel fill is used to construct the road, pad, or airstrip in wet areas, the receiving waters could temporarily have higher suspended solids concentrations and more turbidity. However, since gravel fill construction would take place in winter, water quality impacts would be limited to the entrainment of fine-grained fill material in runoff from the facilities during the spring thaw and/or during precipitation events during the summer following construction.

The primary effect on water quality from construction and placement of gravel structures relates to upslope impoundment and thermokarst erosion (Walker et al. 1987). Thermokarst erosion, partially caused by tundra disturbance and partly by the thermal effect of dust blown off the gravel onto the tundra, can result in water features with high turbidity and suspended-sediment concentrations. Thermokarst erosion could cause the state turbidity standard to be exceeded within and downflow of thermokarst features. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 2,800 acres for the Alternative A FFD scenario.

- Alkalinity and pH

Annual ice-road construction could cover between 40 and 125 acres each year, on average, during construction activities. Ice-road construction could affect water quality through changes in water chemistry along the roadbed during and after meltout. As described above, the water withdrawn from lakes to construct the roadway is relatively more saline than typical snowmelt waters. In addition, the salts frozen into the ice road would leach out of the ice before it melts during snowmelt, increasing initial salt content of the meltwater. This effect could potentially occur during initial snowmelt, but the effect on water quality should be localized, most likely expressed as a slight buffering of pH during initial snowmelt.

Alternative A – Summary of Impacts (CPAI and FFD) on Surface Water Quality

Potential surface water quality impacts for the CPAI Development Project generally fall into three general source categories:

1. Accidental release of fuels and other substances, including oil spills, which could occur during both the construction and operation periods
2. Reductions in dissolved oxygen and changes in ion concentrations in lakes used for water supply, which would occur mainly during construction but could also happen during operations
3. Increases in terrestrial erosion and sedimentation causing higher turbidity and suspended solids concentrations, which would could occur during both the construction and operational periods.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Surface Water Quality

No additional measures have been identified to mitigate impacts to water quality under Alternative A or Alternative A FFD.

4A.2.2 Atmospheric Environment

Air pollutants generated in the Plan Area will consist of emissions from mobile, stationary, portable and fugitive sources from activities occurring in the construction, drilling, and operational phases. Mobile sources would include construction equipment, such as graders and haul trucks, and equipment from aircraft flights and vehicular traffic, such as passenger vehicles and light-duty trucks. Stationary sources would include fossil fuel combustion equipment, such as power generation turbines and backup emergency generator engines, and production and drillsite heaters. Portable sources are the drill rig engines, associated boilers, and heaters used during drilling operations. Fugitive sources are typically road dust from construction. However, the arctic climate prevents most fugitive dust from occurring; thus, it would be an insignificant source in the Plan Area.

The proposed CPAI Development Plan will create new sources of air emissions within the Plan Area. A gas-fired drillsite heater will be included at each of the five production pads (CD-3 through CD-7), and diesel-fired emergency generators will be installed at CD-3 and CD-6, assuming that all sites but CD-3 will be road-accessible. If they are not road-accessible, diesel-fired emergency generators will be added to those sites, resulting in an additional 44 tons per year of criteria pollutant emissions.

The ACX3 (Alpine Capacity Expansion) will receive a gas-fired Frame 5 power turbine (rated at 36,700 HP) for generation of electricity, and a gas-fired heater.

FFD would add seven additional pads to the Colville River Delta, along with CD-3 and CD-4, each requiring a gas-fired drillsite heater. Emergency generators for each of the seven pads are a worst-case scenario, but might not be required.

FFD would add 11 new pads in the Fish-Judy Creeks Facility Group, along with corresponding drillsite heaters and emergency generators. This group also would include the APF-2, and would be the largest source of criteria pollutant emissions in the FFD. For the purpose of this discussion, it is assumed that the additional processing facilities would be similar to the Alpine CPF, with a similar emissions inventory.

The Kalikpik-Kogru Rivers Facility Group would include four new production pads and the hypothetical processing facility APF-3.

An inventory of the project sources and their respective air emissions appears below in tabular format according to the construction, drilling, and operational phases of the project. Table 4A.2.3-1, the Construction Phase Source Inventory, shows potential construction equipment, size (by horsepower rating), and the typical criteria pollutant emissions in pounds per hour. Construction emissions would vary according to the operational hours and loading of each piece of equipment during the construction phase.

Table 4A.2.3-2 presents the Drilling Phase Source Inventory and Emissions Summary in tons per year. Only the criteria pollutants NO_x, sulfur dioxide (SO_2), and carbon monoxide (CO) are listed, as the project would be a minor source of paticulatematter (PM_{10}) and VOCs. The annual emissions shown on this table are based on the current maximum permitted emissions and operational hours conditioned in the existing Alpine CPF Operating Permit, as issued August 8, 2003. Permit conditions would likely expand during the permitting review of the proposed CPAI Development Plan.

Table 4A.2.3-3 is the Operational Phase Source Inventory and Emissions Summary. This table delineates the operational sources of the proposed CPAI Development Plan and FFD by facility groups. Operating hours and maximum emissions are likewise based upon current Operating Permit conditions.

A map of the Alternative A layout is shown in Figure 2.3.3.1-1. A map of the FFD Alternative A is shown in Figure 2.4.1.2-1.

TABLE 4A.2.3-1 CPAI DEVELOPMENT PLAN – CONSTRUCTION PHASE SOURCE INVENTORY AND EMISSIONS SUMMARY

Equipment	Fuel Type	Rating (HP)	Emissions, (lb/hr)				
			NO_x	SO_2	CO	PM10	VOC
Dump Truck[a]	Diesel	235	7.3	0.5	1.6	0.5	0.6
Dumper, 4-ton[a]	Diesel	200	6.2	0.4	1.3	0.4	0.5
Flat beds/tractor trucks[a]	Diesel	250	7.8	0.5	1.7	0.6	0.6
Fork Lifts 3-ton[a]	Diesel	75	2.3	0.2	0.5	0.2	0.2
Front Loader[a]	Diesel	140	4.3	0.3	0.9	0.3	0.3
Grader[b]	Diesel	150	3.8	0.5	1.3	0.4	0.3
Mobile Crane, 30-ton[a]	Diesel	100	3.1	0.2	0.7	0.2	0.2
Mobile Crane, 60-ton[a]	Diesel	200	6.2	0.4	1.3	0.4	0.5
Mobile Crane, 80-ton[a]	Diesel	250	7.8	0.5	1.7	0.6	0.6
Shovel[a]	Diesel	100	3.1	0.2	0.7	0.2	0.2
Transit Mixers[a]	Diesel	250	7.8	0.5	1.7	0.6	0.6
Vibro Roller[b]	Diesel	42	0.9	0.0	0.3	0.1	0.1
Water truck[b]	Diesel	200	4.2	0.5	1.8	0.3	0.2
TOTAL			**64.7**	**4.6**	**15.4**	**4.7**	**5.0**

Note:

Construction emissions would vary according to the operational hours and loading of each piece of equipment during the construction phase. Air pollutant emissions shown were calculated based on emissions factors and the equipment rating. The emissions impact of the construction phase would be determined based upon loading and operational hours.

[a] From USEPA AP-42 Compilation of Air Pollutant Emissions Factors, Volume 2, Mobile Sources

[b] From: SCAQMD CEQA Air Quality Handbook, Table 9-8-C

TABLE 4A.2.3-2 CPAI DEVELOPMENT PLAN – DRILLING PHASE SOURCE INVENTORY AND EMISSIONS SUMMARY

Drilling Phase Source Inventory		Maximum emissions, tons/year		
Equipment	Annual operating hrs	NO_x	SO_2	CO
Doyon Drilling Rig 19, Mud Plant and Bulk Plant[a]				
Caterpillar D398TA Power, 700 kW (4)[b]	820 total	9.33	0.42	2.04
Caterpillar D398TA Power, 976 kW (2)[b]	270 total	4.28	0.19	0.93
Caterpillar 3406 Rig Move Engine, 376 hp[c]	385	2.23	0.08	0.48
Caterpillar 3114 Pipe Shed Move Engine, 105 hp[c]	1390	2.25	0.08	0.49
Caterpillar D379TA Rig Camp Engines (2), 379 kW[c]	900 total	7.05	0.25	1.53
Caterpillar 3176 Cement pumps (2), 180 kW[c]	1,000 total	3.73	0.13	0.81
Superior Boilers (2), 3.4 MMBtu/hr[d]	8,380 total	0.50	0.48	0.12
Tioga Heater, 4.2 MMBtu/hr[d]	6,665	0.49	0.48	0.12
Tioga Heater, 3.5 MMBtu/hr[d]	8,000	0.49	0.48	0.12
Lister Heater, 4,0 MMBtu/hr[d]	7,000	0.49	0.48	0.12
Mud Plant Boiler, 1.3 MMBtu/hr[d]	8,760	0.20	0.19	0.05
Detroit 6063-GK35 Power, 300 kW[c]	500	3.10	0.11	0.67
Detroit 6063-GK35 Power, 160 kW[c]	500	1.66	0.06	0.36
Total Drilling Emissions		**26.66**	**3.02**	**5.85**

Notes:

[a] From Operating Permit 489TVP01 for the Alpine Central Processing Facility (8/8/03).

[b] Emissions calculated utilizing USEPA AP-42 Emissions Factors for Large Stationary Diesel and All Stationary Dual-Fuel Engines (Table 3.4-1)

[c] Emissions were calculated utilizing USEPA AP-42 Emissions Factors for Uncontrolled Diesel Industrial Engines (Table 3.3-1)

[d] Emissions were calculated utilizing USEPA AP-42 Criteria Pollutant Emissions Factors for Fuel Oil Combustion (Table 1.3-1), except sulfur content by weight is calculated at 0.135% pursuant to Operating Permit conditions.

Hp = horsepower

KW = kilowatt

MMBtu/hr= million British thermal units per hour

TABLE 4A.2.3-3 CPAI AND FULL-FIELD DEVELOPMENT PLAN – OPERATIONAL PHASE SOURCE INVENTORY AND EMISSIONS SUMMARY[a]

Operational Phase Source Inventory – Proposed					
Location	Equipment [b,c,d,e]	Annual operating hrs	Maximum emissions tons/year		
			NO_x	SO_2[f]	CO
CD-3	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
	Emergency generator, diesel-fired, 500 kW	4000	32.5	4.3	7.1
CD-4	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
CD-5	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
CD-6	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
	Emergency generator, diesel-fired, 500 kW	4000	32.5	4.3	7.1
	Power generator, gas-fired, 1.2 MW	8760	183.17	0.03	24.84
CD-7	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
ACX3	Frame 5 turbine, 36,700 hp	8760	147.3	1.05	94.0
ACX3	Heater, gas-fired 30 MMBtu/hr	8760	13.1	*	9.2
TOTAL			**452.57**	**9.68**	**172.74**

TABLE 4A.2.3-3 CPAI AND FULL-FIELD DEVELOPMENT PLAN – OPERATIONAL PHASE SOURCE INVENTORY AND EMISSIONS SUMMARY[a] (CONT'D)

Operational Phase Source Inventory – Full-Field Development					
Colville River Delta Facility Group					
CD-3	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
	Emergency generator, diesel-fired, 500 kW	4000	32.5	4.3	7.1
CD-4	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
	Drillsite heater, gas-fired, 20 MMBtu/hr at each of 7 additional pads	8760 each	61.32	*	42.9
	Emergency generator, diesel-fired, 500 kW at each of 7 additional pads	4000 each	227.7	30.38	49.7
TOTAL			**339.12**	**34.68**	**111.9**
Fish-Judy Creeks Facility Group					
CD-5	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
CD-6	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
	Emergency generator, diesel-fired, 500 kW	4000	32.5	4.3	7.1
	Power generator, gas-fired, 1.2 MW	8760	183.17	0.03	24.84
CD-7	Drillsite heater, gas-fired, 20 MMBtu/hr	8760	8.8	*	6.1
11 pads	Drillsite heater, gas-fired, 20 MMBtu/hr at each of 11 additional pads	8760 each	96.36	*	67.5
11 pads	Emergency generator, diesel-fired, 500 kW at each of 11 additional pads	4000 each	357.8	4.3	78.1
APF-2	Additional Processing Facility[g]		2,167.0	151.0	324.0
TOTAL			**2,863.23**	**159.63**	**519.84**
Operational Phase Source Inventory – Proposed					
Location	**Equipment[b,c,d,e]**	**Annual operating hrs**	**Maximum emissions tons/year**		
			NO_x	**SO_2[f]**	**CO**
Kalikpik-Kogru Rivers Facility Group					
4 pads	Drillsite heater, gas-fired, 20 MMBtu/hr at each of 4 additional pads	8760 each	35.0	*	24.5
4 pads	Emergency generator, diesel-fired, 500 kW at each of 4 additional pads	4000 each	130.1	17.4	28.4
APF-3	Additional Processing Facility[g]		2,167.0	151.0	324.0
TOTAL			**2,332.1**	**168.2**	**376.9**

Notes:

a Table assumes Alternative A, with all sites except CD-3 road-accessible. (If not road-accessible, add an emergency generator at each site.)

b Drillsite heater emissions are based upon current operating permit emission limits

c Emergency generator emissions are based upon USEPA AP-42 emissions factors for large stationary diesel and dual-fuel engines (Table 3.4-1)

d Power Generator emissions were calculated by using USEPA AP-42 emissions factors for Natural Gas-fired Reciprocating Engines (Table 3.2-2)

e Frame 5 turbine emissions at ACX3 are based upon AP-42 emissions factors for stationary gas turbines (Table 3.1-1), with added control of 68%, assuming 25 parts per million (ppm) NO_x and CO.

f SO_2 permit emission limits are 200 parts per million by volume (ppmv) hydrogen sulfide (H2S) in fuel gas; and a sulfur content of 0.135% by weight in fuel oil

g Maximum emissions are based upon the current Potential to Emit (PTE) of the Alpine CPF, which also includes 27 tons per year of VOC and 43 tons per year of PM-10, for a total PTE of 2,712 tons per year.

MW = megawatt

4A.2.2.1 Climate and Meteorology

Short-term impacts to climate and meteorological conditions from the project are unlikely to occur. Long-term impacts to climate and meteorological conditions could be caused in part by greenhouse gas (GHG) emissions, but are unlikely to occur as a result of the project because of the very small incremental contribution of project GHG emissions compared not only to existing North Slope GHG emissions but, more importantly, to the global GHG emissions budget.

A discussion of GHG emissions and potential global warming as a result of GHG emissions and their impact on climate changes is presented in more detail in Section 4F.

Alternative A – CPAI Development Plan Impacts on Climate and Meterology

Construction Period

Construction activities would emit some GHG over a short-term period from fossil fuel combustion of construction equipment (graders, bulldozers, trucks, etc.) and from aircraft flights transporting construction crew and materials.

Operation Period

To a lesser extent and over a longer term, GHG emissions would occur from operation of the gas-powered heaters and diesel backup generators, and from mobile sources such as vehicular traffic and aircraft takeoffs and landings.

Alternative A – Full-Field Development Plan Impacts on Climate and Meterology

Colville River Delta Facility Group

Some GHG emissions would result from activities at the production pads CD-3 and CD-4, plus the additional seven production pads.

Fish-Judy Creeks Facility Group

GHG emissions would be somewhat greater than in the Colville River Facility Group because of operations of the hypothetical processing facility APF-2.

Kalikpik-Kogru Rivers Facility Group

GHG emissions would be somewhat greater than in the Colville River Delta Facility Group because of operations of the hypothetical processing facility APF-3, but somewhat less than GHG emissions from Fish-Judy Creeks Facility Group because of a smaller number of new production pads.

Alternative A – Summary of Impacts (CPAI and FFD) on Climate and Meterology

GHG emissions would occur during construction and drilling activities from operation of fossil fuel combustion equipment. Because construction does not occur at a single location for any significant length of time, the impact of these GHG emissions at any single location would be minor and short-term. GHG emissions would also occur over a longer period from operation of the CPAI and FFD. However, GHG generated from construction, drilling, and operational activities should have a minimal effect upon the air quality of the region.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Climate and Meterology

No mitigation measures have been identified. Cumulative impacts of GHG upon climate change are discussed in Section 4F.

4A.2.2.2 Air Quality

Alternative A – CPAI Development Plan Impacts on Air Quality

<u>**Construction Period**</u>

Emissions of criteria pollutants would be produced during construction of the CPAI Project. Construction of the all-weather gravel roads, gravel airstrip, pipelines, and five production pads would cause temporary reduction of local ambient air quality as a result of emissions generated by construction equipment.

Primary emissions during construction activities would result from heavy equipment exhaust (earth movers, trucks, etc.), electric power generators, heaters, and other fuel-burning equipment. These emissions would consist primarily of NO_x, SO_2, particulate matter at the 10-micron and 2.5-micron levels (PM_{10} and $PM_{2.5}$), and CO.

Respirable particulate matter in the form of dust generated by mechanical disturbance of soil would be negligible because of frozen soil and snow cover during winter construction operations.

Emissions would occur during equipment movement and site preparation activities. Because construction does not occur at a single location for any significant length of time, the impact of these emissions at any single location would be minor and short-term. The emissions from construction vehicles and equipment would also be minor and have a short-term impact on the air quality of the region, provided that construction equipment is properly maintained.

Air emissions would result from construction of the gravel roads, primarily because of exhaust from fossil-fueled combustion equipment and particulate emissions from gravel and fugitive road dust. Combustion equipment would consist of B-70 haul trucks, bulldozers, grading equipment, vibratory compactors, and tanker truckers (if road watering is required). Snow removal equipment would be used as necessary. Bridge construction would require cement transit mixers for concrete tower construction.

Pipeline construction would involve the use of cranes, tractor-trailer trucks, welding equipment and other support equipment. Drilling rigs could be diesel-powered, utilizing fuel transported from CD-1. The drilling rigs will initially use diesel and then switch to high line power as it becomes available from Alpine.

Bulldozers, excavator/loaders, haul trucks, drill rig/compressor, and road graders would be utilized to excavate gravel from the gravel mines.

Aircraft would bring materials and crew to the construction sites. The construction phase would require about 40 to 70 one-way aircraft flights per months initially, increasing to 180 in the summer of 2005, and peaking to 340 in the summer of 2006. Winter flights are anticipated to be 60 to 70 one-way trips per month. Table 2.3.10-1 presents a table of the Alternative A Traffic Estimates, which shows the breakdown of one-way aircraft flights per month for the construction, drilling, and operations phases of the applicant's proposed project.

Table 4A.2.3-4 shows emissions per landing/takeoff cycle from a typical Twin Otter business turboprop aircraft, utilizing USEPA AP-42 emission factors for mobile sources for gas turbine engines specific to a Pratt Whitney PT6A-27 engine (USEPA 1985, Table II-1-9 Emission Factors Per Aircraft Per Landing/Takeoff Cycle – Civil Aircraft).

TABLE 4A.2.3-4 CRITERIA POLLUTANT EMISSIONS FROM AIRCRAFT FLIGHTS, PER LANDING/TAKEOFF CYCLE (LTO) UNDER ALTERNATIVE A

Construction Phase[a]	Aircraft Flights (LTO)/ mo, one-way[b]	CO[c] lb/mo	NO_x[d] lb/mo	HC[e] lb/mo	SO_x[f] lb/mo
Summer 2004	40	286.4	32.8	203.2	7.2
Winter 2004/05	70	501.2	57.4	355.6	12.6
Summer 2005	180	1288.8	147.6	914.4	32.4
Winter 2005/06	60	429.6	49.2	304.8	10.8
Summer 2006	340	2434.4	278.8	1727.2	61.2
Winter 2006/07	70	501.2	57.4	355.6	12.6
Winter 2007/08	43	307.88	35.26	218.44	7.74
Summer 2008	100	716	82	508	18
Winter 2008/09	30	214.8	24.6	152.4	5.4
Summer 2010	100	716	82	508	18
Drilling Phase					
Winter 2005/06	80	572.8	65.6	406.4	14.4
Winter 2006/07	80	572.8	65.6	406.4	14.4
Winter 2007/08	80	572.8	65.6	406.4	14.4
Winter 2008/09	80	572.8	65.6	406.4	14.4
Winter 2009/10	80	572.8	65.6	406.4	14.4
Winter 2010/11	80	572.8	65.6	406.4	14.4
Operations Phase					
Summer 2006	24	171.84	19.68	121.92	4.32
Winter 2006/07	24	171.84	19.68	121.92	4.32
Summer 2007	24	171.84	19.68	121.92	4.32
Winter 2007/08	24	171.84	19.68	121.92	4.32
Summer 2008	24	171.84	19.68	121.92	4.32
Winter 2008/09	24	171.84	19.68	121.92	4.32
Summer 2009	24	171.84	19.68	121.92	4.32
Winter 2009/10	24	171.84	19.68	121.92	4.32
Summer 2010	24	171.84	19.68	121.92	4.32
Winter 2010/11	24	171.84	19.68	121.92	4.32

Source: USEPA, 1985. Compilation of Air Pollutant Emission Factors, Volume II, Mobile Sources, Table II-1-9 Emission Factors Per Aircraft Per Landing/Takeoff Cycle – Civil Aircraft.

Notes:

Emissions were calculated for a DeHavilland Twin Otter turboprop aircraft (USEPA Class P2), Pratt & Whitney Model PT6A-27. Emissions factors are a composite of Table II-1-3 and Table II-1-5 in the source document, consisting of the following: 1) typical duration in minutes for civil aircraft landing/takeoff (LTO) cycles at large congested metropolitan airports, based on taxi/idle out, takeoff, climbout, approach, taxi/idle (Table II-1-3); and 2) engine power settings for typical LTO commercial cycles by percentage thrust or horsepower (Table II-1-5).

[a] Summer = May through September; Winter = October through April

[b] One-way aircraft flights given are average (low-high) monthly estimates. One-way aircraft flights were used, in lieu of separate round trips, because flights could be linked from one pad to another. Summer/winter seasons that have no projected aircraft flights for that phase were not included.

[c] Carbon monoxide

[d] Nitrogen oxides reported as NO_2

[e] Total hydrocarbons - volatile organics, including unburned hydrocarbons and organic pyrolysis products

[f] Sulfur oxides and sulfuric acid reported as SO_2

Operation Period

The drilling operations would be a source of air emissions from diesel-powered electricity generators to power drill rig engines, as would the space heaters and boilers used to heat the rig during freezing temperatures. (Drilling also would occur during the construction period).

Criteria emissions produced during the operation of the production pads would be combustion products from the combustion of diesel fuel, primarily NO_x and CO, produced by the heaters and power generators utilizing diesel. Final operating restrictions would be determined during permitting to ensure compliance with state and federal regulations. CPAI would install a gas-fired production heater at each of the five pads. Diesel-powered emergency backup generators would be installed at CD-3 and CD-6. A 1.2 MW power generator would also be installed at CD-6. The ACX3 would be equipped with a Frame 5 turbine generator (36,700 hp), and possibly a gas-fired heater. These equipment items assume that all roads except CD-3 are accessible. If not all pads are road accessible, emergency generators would be added.

Air emissions would occur from fuel combustion as a result of operation of aircraft at the airstrips and from boat engines at the boat ramp. Aircraft flights during the drilling phase are anticipated during the winters at 70 to 90 one-way aircraft flights per month. Aircraft flights during the operational phase would start in summer of 2006 at about 24 one-way aircraft flights per month. Table 4A.2.3-4 presents a summary of estimated air emissions from aircraft flights.

The proposed project would not have consequential air emissions under normal operating conditions. The production pads would be subject to federal and state air quality regulations that are driven by the Clean Air Act (CAA). Section 109 of the CAA of 1970 required the USEPA to establish specific standards for the quality of ambient air (see Table 4A.2.3-5). To date, the USEPA has issued NAAQS for the ambient concentrations of six criteria pollutants: NO_2, SO_2, PM_{10} and $PM_{2.5}$, CO, O_3, ozone,and lead. Alaska has adopted these federal standards. Strict adherence to applicable regulations would minimize the potential air quality impacts from this pipeline project.

The Alpine CPF is permitted for equipment that is subject to federal NSPS, published in 40 CFR Part 60, including: Subpart Dc Small Industrial-Commercial-Institutional Steam Generating Units (dual-fired heaters rated at 20 MMBtu/hr); Subpart GG Standards of Performance for Stationary Gas Turbines (generator turbines); Subpart Kb Volatile Organic Liquid Storage Vessels (Tanks); and Subpart KKK Equipment Leaks of VOC from Onshore Gas Processing Plants, although the USEPA is currently assessing the applicability of Subpart KKK at the request of CPAI. The air quality permit prescribes monitoring, record keeping, and reporting procedures for maintaining compliance with NSPS. As new equipment is added under the proposed project, NSPS requirements could apply, such as Subpart GG to the Frame 5 turbine at ACX3.

The ASDP is an existing major source under the federal requirements of the Prevention of Significant Deterioration (PSD). It is subject to PSD pre-construction review because net emission increases associated with the proposed project will exceed 40 tons per year of NO_x or 100 tons per year of CO.

TABLE 4A.2.3-5 FEDERAL AMBIENT AIR QUALITY STANDARDS

Air Pollutant	Federal Primary Standard Concentration/ Averaging Time	Most Relevant Effects
Ozone (O_3)	0.12 ppm, 1-hr avg.,(235 μg/m^3) 0.08 ppm, 8-hr avg.[a] (157 μg/m^3)	(a) Short-term exposures: (1) Pulmonary function decrements and localized lung edema in humans and animals; (2) Risk to public health implied by alterations in pulmonary morphology and host defense in animals; (b) Long-term exposures: Risk to public health implied by altered connective tissue metabolism and altered pulmonary morphology in animals after long-term exposures and pulmonary function decrements in chronically exposed humans; (c) Vegetation damage; (d) Property damage
Carbon Monoxide (CO)	9 ppm, 8-hr avg. (10 mg/m^3) 35 ppm, 1-hr avg. (40 mg/m^3)	(a) Aggravation of angina pectoris and other aspects of coronary heart disease; (b) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease; (c) Impairment of central nervous system functions; (d) Possible increased risk to fetuses
Nitrogen Dioxide ($N0_2$)	0.053 ppm, annual arithmetic mean (100 μg/m^3)	(a) Potential to aggravate chronic respiratory disease and respiratory symptoms in sensitive groups; (b) Risk to public health implied by pulmonary and extra-pulmonary biochemical and cellular changes and pulmonary structural changes; (c) Contribution to atmospheric discoloration
Sulfur Dioxide ($S0_2$)	0.030 ppm, annual arithmetic mean (80 μg/m^3) 0.14 ppm, 24-hr avg. (365 μg/m^3)	(a) Bronchoconstriction accompanied by symptoms which could include wheezing, shortness of breath and chest tightness, during exercise or physical activity in persons with asthma
Suspended Particulate Matter (PM_{10}) Particulate Matter ($PM_{2.5}$) [a]	50 μg/m^3, annual arithmetic mean 150 μg/m^3, 24-hr avg. 15 μg/m^3, annual arithmetic mean 65 μg/m^3, 24-hr avg.	(a) Excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease; (b) Excess seasonal declines in pulmonary function, especially in children
Lead	1.5 μg/m^3, calendar quarter	(a) Increased body burden; (b) Impairment of blood formation and nerve conduction

Source: 40 CFR Part 50

Notes:

[a] The ozone 1-hour standard applies only to areas that were designated nonattainment when the ozone 8-hour standard was proposed in July 1997. This provision allows for a smooth, legal, and practical transition to the 8-hour standard. The ozone 8-hour standard and the PM2.5 standards were recently promulgated after extended litigation and are included for information only until the USEPA can promulgate designations of attainment and nonattainment.

μg/m^3 = microgram per meter cubed

ppm = parts per million

Parenthetical value is an approximately equivalent concentration.

CPAI conducted dispersion modeling for its construction permit application submitted to ADEC in July 2001 to assess air quality impacts, which demonstrated by worst case analysis that the project would not significantly have an impact on Class II increments, nor would impacts occur to soil, vegetation, or visibility. A Class I analysis was not required since the Plan Area would not be located within 60 miles of a Class I area.

The Alpine facility is an existing major source under Title V of the CAA Operating Permit requirements (Part 70), with an annual Potential to Emit of 2,711 tons per year of regulated air pollutants. The Project would trigger a modification to the Part 70 Operating Permit.

The APF-1 is subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) under Section 112 of the Clean Air Act, specifically Subpart E for Mercury for its existing sludge incineration plants. The proposed Project under this Alternative, however, would not trigger a major source of HAP (either 10 tons per year of a single HAP or 25 tons per year of a combination of HAPs), so additional NESHAPs would not apply.

Alternative A – Full-Field Development Plan Impacts on Air Quality

Air pollutant emissions would be generated by two additional APFs, possibly at the level of two times the current APF, which is permitted for 2,711 tons per year of regulated pollutants. However, the cumulative impact of emissions from FFD would affect ambient air quality to an unknown extent without first conducting dispersion modeling. Air quality impact analysis would be conducted under PSD preconstruction review, because the FFD expansion would likely trigger the PSD thresholds for NO_x and CO. If the FFD would cause a significant impact to the ambient air quality, additional control technology would be required.

HAP emissions would increase from installation of 22 drillsite heaters and 22 emergency generators, along with the HAPS associated with the two APFs. Since HAPS are associated with total VOC emissions, it is unlikely that a single 10-ton HAP source would result from the FFD expansion, so additional NESHAPS would not be required.

Alternative A – Summary of Impacts (CPAI and FFD) on Air Quality

Construction impacts would contribute air emissions to the regions but are short-term and transient in nature and will not have a lasting impact to air quality. Aircraft landings and takeoffs will occur in all phases of CPAI and FFD, predominately during construction. Air impacts from aircraft trips, which would also be short-term and transient, are not regulated by the permitting process.

The Project would not emit consequential air pollutants under normal drilling and operating conditions of the CPAI. Impacts from FFD would be more substantial because of the addition of two APFs and would need to be evaluated by an air quality impacts analysis under the PSD permitting process.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Air Quality

Air quality impacts from the project would be limited through the permitting process, which ensures that no significant new air pollution sources contribute to a deterioration of the ambient air quality. No additional measures have been identified to mitigate impacts to air quality under Alternative A or Alternative A FFD.

4A.2.2.3 Noise

Noise quality can be affected during construction, drilling, and operations phases of a project. The ambient sound level of a region is defined by the total noise generated, including sounds from both natural and artificial sources. The magnitude and frequency of environmental noise could vary considerably over the course of the day and throughout the week, in part because of changing weather conditions and the effects of seasonal vegetative cover. Federal agencies use two measurements to relate the time-varying quality of environmental noise to its known effect on people: the 24-hour equivalent sound level ($Leq_{(24)}$) and the day-night sound level (L_{dn}). The $Leq_{(24)}$ is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the $Leq_{(24)}$ with 10 dBA added to nighttime sound levels between the hours of 10 p.m. and 7 a.m., to account for people's greater sensitivity to sound during nighttime hours.

The basis for evaluation of noise impact is an L_{dn} of 55 dBA, the level that protects the public from indoor and outdoor activity interference in residential areas. Noise impact must be mitigated if, during operations, noise attributable to the operation of the facility would exceed an L_{dn} of 55 dBA at nearby Noise Sensitive Areas (NSAs) such as residences or if applicable state and local noise regulations would be exceeded.

To assess the noise impacts of the Project, an evaluation of the following significance criteria is conducted to determine if the Project would:

- Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Expose persons to or generate excessive groundborne vibration or groundborne noise levels.
- Create a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the Project.
- Create a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project.
- Expose people residing or working in the Plan Area to excessive noise levels for a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport
- Expose people residing or working in the Plan Area to excessive noise levels, for a project within the vicinity of a private airstrip,.

In community noise impact analysis, a long-term noise increase of 5 to 10 dBA is considered to impact the noise quality of the community to some degree. Most people begin to notice changes in environmental noise at about 5 dBA. Noise levels below 5 dBA cannot definitively be demonstrated as producing an adverse impact. Noise level increases above 10 dBA are generally considered to have a severe impact. For short-term noise increases (for example, construction activities), the typical severe threshold increase is 15 dBA, depending upon whether the noise level fluctuates, has a high frequency, or is accompanied by subsonic vibration.

Alternative A – CPAI Development Plan Impacts on Noise

Construction Period

Construction of the project is expected to be typical of other development projects in terms of schedule, equipment used, and other types of activities. It is expected that construction of the proposed facilities would increase noise levels in the vicinity of the Plan Area. Project construction noise levels would vary during the construction period, depending on the construction phase. Construction equipment would be operated on an as-needed basis during this period and would be maintained to manufacturer's specifications to minimize noise impacts. Although individuals in the immediate vicinity of the construction ac tivities would experience an increase in noise, this effect would be local and temporary, lasting only during days of construction (primarily winter) and, other than drilling, usually occurring at a given location for only part of one winter season. Drilling for CD-3 would occur in five to seven successive winters, that at CD-4 over four successive summers, and other pads over approximately a year and a half.

The construction of the project gravel roads, drilling and production pads, and pipelines would cause temporary increases in the ambient sound environment in the immediate vicinity of the construction sites. Typical construction equipment, such as a dump truck, backhoe, concrete mixer, and other trucks and cranes, creates noise levels of about 85 to 91 dBA at a distance of 50 feet (USEPA 1971). Grading activities, however, would mitigate noise caused by loud rattling of truck travel on potholed roads.

During drilling activities, the Project could expose persons to or generate excessive groundborne vibration or groundborne noise levels from drill rigs, where noise levels would be about 82 to 92 dBA at a distance of 82 feet (Hampton, et al. 1988). However, drill rigs are totally enclosed with windwalls and arctic insulation, which provides adequate soundproofing to noise exposure outside the rig complex. Enclosure and winterization of rigs should reduce the drilling operation noise impacts to 70 dBA or below outside operational area. The nearest sensitive area is the village of Nuiqsut, which is about 5 miles south of CD-4.

Noise would affect the local environment during construction or extension of the proposed access roads. Construction would proceed at rates ranging from several hundred feet to several miles per day. However, because of the assembly line method of construction, activities in any one area could last several weeks. Construction equipment would be operated on an as-needed basis during this period. Although individuals in the immediate vicinity of the construction activities could experience annoyance, the impact on the noise environment at any specific location along the route would be short term.

Noise associated with the construction or extension of access roads and aboveground pipelines would be intermittent during the construction period at any single location and would vary from hour to hour depending on the equipment in use and the operations being performed. The overall impact would be temporary and would not be expected to be significant.

Operation Period

During operational drilling, the potential noise impacts would be limited to the vicinity of the power generation engines and drilling rig engines, which would have equipment decibel ratings of about 85 dBA and 110 dBA, respectively. Principal noise sources would include the air inlet, exhaust, and casing of the engines or turbines. Secondary noise sources would include cooling fans, yard piping, and valves. Noise from relief valves and emergency electrical generation equipment would be infrequent.

Generally, the equipment in the Plan Area will operate at a decibel level of about 70 dBA for less than 1,000 feet if properly mitigated by noise minimization measures such as mufflers on the exhaust systems of engines and turbines. With noise mitigation there will not be long-term impacts to the nearby village of Nuiqsut. Workers in the Plan Area would be subject to Occupational Safety and Health Administration (OSHA) standards for hearing protection as necessary.

Operation of the access roads after construction of the proposed project would not significantly exceed their use. The Project will utilize a small twin-engine aircraft. In 1997, the use of a small aircraft was evaluated for the ADP versus a larger Boeing 737 for crew transport. The Boeing 737 could transport 120 passengers compared to 19 passengers onboard the small aircraft. However, the smaller aircraft was selected to mitigate noise impacts to residents in the nearby village of Nuiqsut. However, this noise mitigation measure requires more trips to transfer crew and materials.

The highest use of the CD-3 airstrip would occur during non-ice road months for material re-supply. During the summer, a small single- or twin-engine fixed wing aircraft would be utilized to transport operation and maintenance personnel to the site. A higher frequency of use would occur during production start-up, after which it would decline at a steady rate. A single-engine propeller at 1,000 feet emits a noise level of 66 to 76 dBA. Table 4A.2.3-4 indicates the estimated one-way aircraft flights per month. The noise impacts from the use of aircraft during construction would be considerably greater than during the operational phase, where 24 one-way aircraft flights per month are projected.

Noise levels from passing helicopters vary among aircraft models and atmospheric conditions. Typically, the noise from passing helicopters ranges between 68 to 78 dBA during a flyover (at about 1,300 feet) but is only detectable for 30 seconds. The FAA's minimum flight heights would not apply to helicopters.

Alternative A – Full-Field Development Plan Impacts on Noise

Additional construction and drilling at the two hypothetical additional processing facilities and the 22 hypothetical additional production pads would extend the noise impacts over a longer period of time and over a wider area. Additional aircraft trips during construction would occur under the FFD Plan. Since the community of Nuiqsut is several miles from all but one of the hypothetical pads , noise impacts would be minimal.

Alternative A – Summary of Impacts (CPAI and FFD) on Noise

During peak periods of construction and drilling, noise levels would be considerably higher than during operations, but would be short-term, and would not occur for all proposed production pads at the same time. Nuiqsut is several miles from the nearest proposed development, so noise impacts would be minor unless, under FFD, a development occurred much closer to the village.

Alternative A – Potential Mitigation Measures (CPAI and FFD) for Noise

No potential mitigation measures have been identified.